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The Effects of Composition on Glass Dissolution Rates: The Application of Four Models to a Data Base

R. W. Geldart

C. H. Kindle

January 1988

Prepared for the U.S. Department of Energy
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TO A DATA BASE

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ABSTRACT

Four models have been applied to a data base to relate glass dissolution in distilled water to composition. The data base is used to compare the predictions obtained from the models in fitting actual data. The usefulness of the data base in formulating a model is also demonstrated.

Two related models in which the composite or pH-adjusted free energy of hydration of the glass is the correlating parameter are compared with experimental data. In a structural model, the nonbridging oxygen content of the glasses is used to correlate glass dissolution rate to composition. In a model formulated for this report, the cation valence and the oxygen content of the glass are compared with observed dissolution rates.

The models were applied to the 28-day normalized silica release at 90°C for over 285 glass compositions with surface area to volume ratios of 10 m^{-1} (Materials Characterization Center MCC-1 glass durability test using distilled water). These glasses included the nonradioactive analogs of WV205 and SRL-165, as well as SRL-131, PNL 76-68, and a European glass, UK209.

Predicted glass dissolution rates show similar fits to the data for all four models. The predictions of the models were also plotted for two subsets of the glasses: waste glasses and Savannah River Laboratory glasses. The model predictions fit the data for these groups much better than they fit the data for the entire set of glasses.

SUMMARY

The Materials Characterization Center at Pacific Northwest Laboratory^(a) has compiled a data base of 285 glass compositions and durability leach test results. Four models that relate glass durability to a priori calculated values have been applied to this data base in order to evaluate the fits of the predictions from the models to a wide range of data.

Three of the glass models have been described previously: one calculates hydration energies, one calculates pH-adjusted hydration energies, and one structural model calculates the number of nonbridging oxygens (NBO) in the glass structure. These models have been applied to a data base of 285 glass compositions to evaluate relative accuracy. A "valence-oxygen model," a variation of the NBO model, was formulated and also applied to the data base.

All four models showed a comparable degree of precision when applied to the full data base using a linear logarithmic relationship [$\ln(r) = A + BX$, where r is the normalized 28-day silica release rate, A and B are unknown constants, and X is the appropriate model parameter]. The fit of each of the models improved as the data were restricted to waste glasses and even more when only Savannah River Laboratory glass data were considered (Figure A). This implies that these models will better predict durability behavior when applied to glasses with similar compositions or, possibly, glasses tested in the same laboratory.

Completion of the data base will help provide the data to demonstrate the composition/durability relationships needed to develop durable waste glasses.

(a) Operated for the U.S. Department of Energy by Battelle Memorial Institute under contract DE-AC06-76RLO 1830.

FIGURE A. The Linear Logarithmic Fit of the Four Models Improved as Related Glass Compositions Were Selected from the Data Base

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INTRODUCTION

The purpose of this study on glass durability and composition is to compare the results of a published free energy model with those of a related structural model, the nonbridging oxygen (NBO) model, and those of a simple empirical (valence-oxygen) model. Correlations among the composition-based models indicate that these models can relate the durability of waste glasses to that of geologic and man-made glasses. This connection can aid in determining the long-term durability of waste glass, and independent models can serve as valuable checks on one another. This comparison of models is based on data from 28 day, 90°C deionized water tests (MCC-1). Other tests using longer times, different conditions or concentrated waters may be more appropriate for some repository simulations.

The conclusions of the study are presented, followed by descriptions of the four models and results of their predictions. Procedures for calculations and a list of glass composition data and model parameters are contained in the appendices. This report describes the application of four models to over 285 glass compositions. This data base is being expanded to compile the majority of glass durability data at a single location.

The purpose of the glass durability models is to establish durabilities for glasses as a function of glass composition. Through these composition/durability relationships, the user will be able to relate the durability of a particular glass to that of other glasses and, in so doing, confirm or deny that the behavior of the glass is normal when compared with other glasses of similar composition. This report describes the comparative evaluation of four models or relationships using a data base of glass durabilities and compositions.

CONCLUSIONS

The nonbridging oxygen (NBO) model, the empirical valence-oxygen model, the free energy of hydration model, and the pH-adjusted free energy model offer similar accuracies in modeling 28-day leaching data from the MCC-1 static test. The NBO and valence-oxygen models are simple structural models that do not include temperature and solution effects that can be included in the free energy models. However, the valence-oxygen model assumes the formation of arbitrarily defined "stable" and "unstable" bonds, and the NBO structural model has predictive discrepancies with the free energy models for individual components. Unlike the structural models, the calculations for the free energy models require that enthalpy and free energy data be gathered, glass constituents and hydration reactions be assumed, and pH contributions be identified.

For groups of similar glasses, such as the Savannah River Laboratory (SRL) glasses, the experimental uncertainty of the glass dissolution rates appears to be close to the standard deviation for all four models, i.e., the model results fit these data very well. This strongly implies that these models will better predict durability behavior when applied to (limited subsets of data from) related glass compositions. Although all the models show correlation with glass dissolution rates, each model would need further improvement before it alone could be used to predict dissolution rate differences for all glasses in the data base.

As the data base is expanded, comparisons between models will include additional breadth, and model development and refinement can be facilitated.

DISCUSSION

KINETICS OF GLASS DISSOLUTION

Three reactions are considered to dominate the dissolution of silicate glasses in an aqueous environment (Paul 1977). The three reactions involved are:

1. Water molecules can attack alkali-oxygen bonds

where R^+ is an alkali metal cation.

2. A hydroxyl ion from solution can attack a siloxane bond in the glass

which produces a nonbridging oxygen.

3. The nonbridging oxygen generated in reaction (2) can combine with a water molecule

to generate another hydroxyl ion.

It was shown by Grambow (1985) that if a reaction scheme similar to this is assumed, the rate of the multicomponent matrix dissolution (r_m) in a dilute solution is given by

$$\ln(r_m) = A - \Delta G_{\text{hyd}}/RT \quad (1)$$

where ΔG_{hyd} = the free energy of hydration for the glass,

R = the gas constant,

T = the desolute temperature, and

A = a constant that varies with temperature.

Thus, the kinetics of glass dissolution as expressed by Grambow are tied to the thermodynamic stability of the glass.

FREE ENERGY MODEL

Free Energy of Hydration Calculations for Glass Dissolution Prediction

In order to calculate the change in free energy for a glass, it is assumed that the free energy of hydration is given by

$$G_{hyd} = RT \ln Q + \Delta G^{\circ}_{hyd} \quad (2)$$

where $RT \ln Q$ = the excess free energy of hydration

Q ($Q = \prod_i a_i^{v_i}$)^(a) = the ratio of activity of the products to the reactants,

a_i = the activity of a product or reactant,

v_i = the associated stoichiometric coefficient, and

ΔG°_{hyd} = the standard free energy of hydration that can be calculated from tabulated data (Brewer and Pitzer 1961).

The solid phase is then assumed to be an ideal solution of n constituents that behave independently of each other in terms of their reactions with water. If each constituent has a mole fraction x_i , then

$$\Delta G_{hyd} = \sum x_i (\Delta G_i^{\circ}_{hyd} + RT \ln Q) \text{ for } i=1 \text{ to } n \quad (3)$$

where $\Delta G_i^{\circ}_{hyd}$ and Q_i are the standard free energy of hydration and activity ratios for component i (Reimus et al. 1986).

(a) $\prod_i$ signifies the product for all values of i .

For glasses in distilled water, when $RT \ln Q$ is neglected, Equation (3) has been used to show that the free energy of hydration provides a general trend between free energy changes and MCC-1 28-day normalized release values, and ultimately the glass dissolution rate (Plodinec, Jantzen, and Wicks 1984; Jantzen and Plodinec 1984; Jantzen 1986; Reimus et al. 1986). At higher pH values, free energy terms have been pH adjusted and shown to improve the fit of the free energy model (Jantzen 1986).

The procedure used to calculate the free energies of hydration for this report is located in Appendix A, along with a comparison of the calculation procedure used by Newton and Paul (1980) and Jantzen and Plodinec (1984).

Uncertainties of the Free Energy Model

The free energy model is useful for examining the durability of waste glasses although there are the following theoretical uncertainties:

- Assumptions about the identity of the glass constituents, their independent and ideal behavior in a glass, and the hydration reactions (Table 1) are reasonable, but they are difficult to confirm.
- Thermodynamic data at 90°C is not always available for calculation of free energies at the same temperature as the experiments (Atkins 1982). As a result, free energies calculated to 25°C are used as the closest approximation.
- Relating thermodynamic values (equilibrium based in dilute solutions) to short-term 28-day experimental data (kinetics impacted in nondilute solutions) is uncertain.
- The pH adjustment of the hydration energy in laboratory tests using unbuffered deionized water may differ from repository groundwater with some degree of natural buffering.
- Should the hydration energy calculations be normalized to the moles of constituents or to moles of glass raw materials? This question is discussed in Appendix A. The absolute values may differ, but the trends are the same.

TABLE 1. Free Energies of Hydration Glass Constituents,
and Corresponding Oxides at 25°C^(a)

Oxide	Glass Constituent	Aqueous Reaction Products		Free Energy of Hydration, kcal/mole
Al ₂ O ₃	Al ₂ O ₃	AlO(OH)		3.04
B ₂ O ₃	B ₂ O ₃	H ₃ BO ₃		-9.93
BaO	BaSiO ₃	Ba ²⁺	H ₂ SiO ₃	-30.57
CaO	CaSiO ₃	Ca ²⁺	H ₂ SiO ₃	-16.116
Cr ₂ O ₃	Cr ₂ O ₃	Cr(OH) ₃		37.36
Cs ₂ O	Cs ₂ SiO ₃	Cs ⁺	H ₂ SiO ₃	-46.82
FeO	FeSiO ₃	Fe ²⁺	H ₂ SiO ₃	-14.609
Fe ₂ O ₃	Fe ₂ O ₃	Fe(OH) ₃		15.5
K ₂ O	K ₂ SiO ₃	K ⁺	H ₂ SiO ₃	-41.735
Li ₂ O	Li ₂ SiO ₃	Li ⁺	H ₂ SiO ₃	-22.74
MgO	MgSiO ₃	Mg ²⁺	H ₂ SiO ₃	-13.888
MnO	MnSiO ₃	Mn ²⁺	H ₂ SiO ₃	-14.871
Na ₂ O	Na ₂ SiO ₃	Na ⁺	H ₂ SiO ₃	-28.815
Nd ₂ O ₃	Nd ₂ O ₃	Nd(OH) ₃		-28.32
NiO	NiSiO ₃	Ni ²⁺	H ₂ SiO ₃	-14.347
P ₂ O ₅	P ₂ O ₅	H ₃ PO ₄		-52.62
PbO	PbSiO ₃	Pb ²⁺	H ₂ SiO ₃	-8.81
Sb ₂ O ₃	Sb ₂ O ₃	N/A		N/A
SiO ₂	SiO ₂	H ₂ SiO ₃		5.59
SrO	SrSiO ₃	Sr ²⁺	H ₂ SiO ₃	-24.4
ThO ₂	ThO ₂	Th ⁴⁺		-2.533
TiO ₂	TiO ₂	TiO(OH) ₂		15.99
UO ₂	UO ₂	UO ₂ (OH)2H ₂ O		-6.8
ZrO ₂	ZrSiO ₄	ZrO(OH) ₂	H ₂ SiO ₃	45.1

(a) The data in this table were obtained from Plodinec, Jantzen,
and Wicks (1984)

NONBRIDGING OXYGEN MODEL

A structural model that is empirically related to the free energy model is the NBO model. It has been shown that the nonbridging oxygen fraction is a good measure of the free energy of hydration and, thus, the normalized silica release (Jantzen and Plodinec 1984). For the purposes of this paper, the NBO structural representation will be referred to as a model, and it will be compared to durability data to see how well it fits empirically.

Description of the Nonbridging Oxygen Model

The proportion of NBO gives an estimate of the degree of crosslinking in the glass (Jantzen and Plodinec 1984), and glass scientists such as Stevels (1948) have related the portion of NBO in the glass to the glass durability as early as 1948. More recently, Jantzen and Plodinec compared a version of the NBO model with the 28-day normalized silica release and showed that a clear correlation exists between NBO and the glass durability. The following formula was used to calculate NBO:

$$\text{NBO} = [2(\text{R}_2\text{O} + \text{RO}) + 6(\text{R}_2\text{O}_3) - 2(\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3) + 4(\text{RO}_2)] / \text{oxide sum} \quad (4)$$

(SiO_2 and B_2O_3 are not included in the calculations.)

The formula assumes that each mole of mono- and divalent oxide components contributes two moles of NBO atoms, and every mole of Al_2O_3 or Fe_2O_3 oxide creates two bridging oxygens. Other trivalent cations are assumed to create three NBO, but tetravalent cations such as zirconium are assumed to create four NBO. A more detailed discussion of the NBO model is beyond the scope of this text but can be found in Jantzen and Plodinec (1984).

A Comparison of the Nonbridging Oxygen and Free Energy Models

Because the NBO model does not assume any glass constituents or hydration reactions, it bypasses many of the assumptions of the free energy model. However, this structural model as applied to durability concerns shows some differences from the free energy model. First, unlike the free energy durability model, the NBO structural model "predicts" that the addition of a mole of R_2O has the same effect on glass durability as the addition of a mole of RO . Also,

tetravalent cations such as zirconium are assumed to increase the NBO concentration and thus decrease the glass durability, contrary to the predictions of the free energy model. Finally, Al_2O_3 and Fe_2O_3 are assumed to increase the durability of glasses to a much greater extent than the free energy model predicts. Despite these specific differences and the application of this structural model to durability processes, the NBO model fits the data as well as the others examined here.

VALENCE-OXYGEN MODEL

To avoid the discrepancies between the free energy of hydration and NBO models, a simple glass dissolution/composition model was developed. This step demonstrates the use of the data base as an aid in model development. The model that was developed is called the valence-oxygen model.

Description of the Valence-Oxygen Model

The valence-oxygen model is based upon the assumption that the relative stability that each cation contributes to a glass is dependent only upon its valence. It was observed by Jantzen and Plodinec (1984) that the ΔG_{hyd} of an oxide is related to the valence of the corresponding cation.

First, to describe the model, some terms are defined. Two terms that are essential to the model are the concepts of "stable" and "unstable" cation/oxygen bonds. It is assumed that any cation with a valence of one will form a single "unstable" cation/oxygen bond. Next, any cation with a valence of X ($X > 1$) will form X "stable" cation/oxygen bonds. (These concepts were arbitrarily defined.) To normalize the number of stable and unstable bonds, the moles of each bond type per mole of glass are divided by the total number of oxygens per mole of glass. In this way, the normalized bond type is not dependent upon the constituents that are chosen to represent each glass. The valence parameter, P , is a term that will be used to calculate relative stabilities of glasses. The definition of this parameter is based on the number of stable and unstable cation/oxygen bonds.

$$p = \frac{(\# \text{ of unstable bonds} + \# \text{ of oxygens for unstable oxides}) - (\# \text{ of stable bonds} - \# \text{ of oxygen atoms for stable oxides})}{\# \text{ of oxygen atoms}} \quad (5)$$

If we let $A = 3\sum(x_{R_2O})$ for all oxides of the form R_2O (This value is the number of moles of unstable cation/oxygen bonds per mole R_2O plus the moles of oxygen per mole R_2O .);

$B = \sum m(x_{R_jO_m})$ for all oxides in which $2m/j > 1$ (B_2O_3 is excluded from the calculation of B .) (B is the number of moles of stable cation/oxygen bonds per mole oxide minus the number of moles of oxygen atoms per mole of oxide.); and

$C = \sum k(x_{R_iO_k})$ for all oxides except B_2O_3 (This is the total moles of oxygen atoms per mole of glass.)

then

$$p = \frac{A - B}{C} \quad (6)$$

A more detailed description of this equation is given in Appendix B.

Because B_2O_3 has high-strength covalent cation/oxygen bonds (Jantzen and Plodinec 1984), it is assumed that it remains in its oxide form and acts independently of the silica/oxygen/cation matrix. For this reason, B_2O_3 is not considered when calculating the stable bond number or the total oxygen content of the glass.

Limitations of the Valence-Oxygen Model

Like the free energy of hydration and NBO models, the valence-oxygen model has many limitations. Unlike the free energy model, the valence-oxygen model does not predict differences that are caused by either temperature variations or variations in aqueous solution compositions. Thus, the valence-oxygen model cannot provide accurate dissolution rates for highly saturated aqueous environments such as repository brines. Also, the model does not predict differences that arise because of variations in similar species. For example, if Na_2O is

replaced by Li_2O , the valence-oxygen model would predict no difference in the dissolution rates, although the free energy model would (Plodinec, Jantzen and Wicks 1984; Jantzen and Plodinec 1984; Jantzen 1986). These differences could possibly be related to the cation size or cation/oxygen bond strengths (Jantzen and Plodinec 1984). A model which includes the ionic radii or bond strengths would likely improve the predictive power of the valence-oxygen model.

DATA BASE RESULTS

Each of the four models was applied to the 28-day dissolution rates of 285 glasses. The models are assumed to follow the logarithmic-linear form $\ln(r) = A + BX$, where r is the normalized 28-day silica release rate, A and B are unknown constants, and X is the appropriate model parameter. This linear form expresses the theoretical relationships for the free energy models although curves may provide closer empirical fits. The same form has also been fit to the NBO and valence-oxygen models to maintain consistency in the analysis of the results. Standard deviations from the best fit lines were calculated for the complete set of glasses, the waste glass subset, and the SRL glass subset. The entire database set is reproduced in Appendix C.

RESULTS OF THE FREE ENERGY OF HYDRATION MODELS

The natural log of the 28-day normalized silica release at 90°C with surface area/volume ratios of 10 m^{-1} was plotted against the standard and the pH-corrected free energies of hydration in Figures 1 and 2, respectively. The data included 285 glasses that consist of many waste glasses, natural glasses, and man-made glasses. The best fit straight lines are shown in Figures 1 and 2. The standard deviations of the natural log of the 28-day normalized silica release from the best fit lines are 1.02 and 0.92 for the two respective figures, and the maximum deviations from the lines are 3.36 and 2.80, respectively. These standard deviations are very similar to those obtained using the calculation procedure used by Jantzen et al., 0.98 and 0.83 (Appendix A). A more-detailed comparison of the results from the two calculation methods is given in Tables 2 through 4.

Two subsets of the leaching data base were also examined. The natural log of the 28-day normalized silica release was plotted against the standard and pH-corrected free energy of hydration for a set of waste glasses (Figures 3 and 4), and for a set of SRL glasses (Figures 5 and 6). The standard deviations of the waste glasses (0.45) and the SRL glasses (0.19) from best fit lines are much less than that for the entire set of glasses, possibly indicating that the glasses within each subset leach by similar mechanisms. It should also be

FIGURE 1. Natural Log of 28-Day Normalized Silica Release Plotted Against Standard Free Energy of Hydration for all Reported Glasses

FIGURE 2. Natural Log of 28-Day Normalized Silica Release Plotted Against pH-Corrected Free Energy of Hydration for all Reported Glasses

FIGURE 3. Natural Log of 28-Day Normalized Silica Release Plotted Against Standard Free Energy of Hydration for a Set of Waste Glasses

FIGURE 4. Natural Log of 28-Day Normalized Silica Release Plotted Against pH-Corrected Free Energy of Hydration for a Set of Waste Glasses

FIGURE 5. Natural Log of 28-Day Normalized Silica Release Plotted Against Standard Free Energy of Hydration for a Set of Savannah River Glasses

FIGURE 6. Natural Log of 28-Day Normalized Silica Release Plotted Against pH-Corrected Free Energy of Hydration for a Set of Savannah River Glasses

noted that the natural logs of the silica releases for identical glasses deviated up to 0.57. This deviation is much higher than the standard deviation of either the waste glasses or the SRL glasses.

RESULTS OF THE NONBRIDGING OXYGEN MODEL

The natural log of the 28-day normalized silica release was plotted against NBO and is shown in Figure 7. The standard deviation from the best fit line (1.16 natural logarithm units) and the maximum deviation from the best fit line (3.79 natural logarithm units) are higher than the deviations for the free energy model. However, the standard deviation from the best fit lines for the waste glasses (0.44 natural logarithm units) and SRL glasses (0.20 natural logarithm units) were much lower than the standard deviation for the entire data set, and the standard deviations are similar to the deviations for the free energy of hydration model (see Tables 2 and 3 and Figures 8 and 9).

RESULTS OF THE VALENCE-OXYGEN MODEL

The natural log of the 28-day normalized silica release was also plotted against the valence parameter for the same set of leaching data used in the free energy of hydration and NBO models. The standard deviation from the best fit line (Figure 10) is 0.97 natural logarithm units, and the maximum deviation is 2.95 natural logarithm units. These values are very similar to those for the free energy model. Plots for a set of waste glasses and a set of SRL glasses are plotted in Figures 11 and 12. The waste glasses (0.50) and SRL glasses (0.20) have standard deviations that are much less than that for the entire data set, as was also the case for the free energy model. Comparisons of the slopes and standard deviations for each model are given in Tables 2 and 3.

FIGURE 7. Natural Log of 28-Day Normalized Silica Release Plotted Against Nonbridging Oxygens for all Reported Glasses

TABLE 2. Standard Deviations from Best Fit Lines for All Models

Model(a)	Standard Deviation, Natural Logarithm Units			Description of Model
	All Glasses(b)	Waste Glasses(b)	SRL Glasses(b)	
Standard free energy of hydration	0.98 ^(c)	0.46	0.19	Assumes independent glass constituents and hydration reactions. Does not depend on solution effects such as pH.
pH-corrected free energy of hydration	0.83 ^(c)	0.45	0.19	Same as the standard free energy model, but includes pH effects.
NBO	1.16	0.44	0.20	A measure of the degree of crosslinking for a glass matrix.
Valence-oxygen	0.97	0.50	0.20	An empirical model to eliminate discrepancies between the free energy and NBO models.

(a) All models are assumed to follow the form $\ln$ (28-day normalized Si release) = A + B*x, where x is the model parameter and B is the reported slope (see Table 3).

(b) A standard deviation of 1 corresponds to an error of 63%, based on the equation that

$$\text{error} = \frac{(\text{predicted rate} - \text{observed rate})}{(\text{the larger of the two values})} \times 100.$$

A deviation of 0.5 corresponds to an error of 40%, and a deviation of 0.2 to an error of 20%. An error of more than 100% is not possible, based on this equation.

(c) Value obtained using the alternative calculation scheme (Appendix A) used by Jantzen et al.

TABLE 3. Slopes of the Best Fit Lines for All Models

Model	Slope for All Glasses (b)	Slope for Waste Glasses (b)	Slope for SRL Glasses (b)	Description of Model
Standard free energy of hydration	-0.28 ^(c)	-0.09	-0.10	Assumes independent glass constituents and hydration reactions. Does not depend on solution effects such as pH.
pH-corrected free energy of hydration	-0.26 ^(c)	-0.10	-0.10	Same as the standard free energy model, but includes pH effects.
NBO	2.97	2.66	2.55	A measure of the degree of crosslinking for a glass matrix.
Valence- oxygen	4.31	1.21	2.62	An empirical model to elim- inate discrepancies between the free energy and NBO models.

- (a) All models have been fit to the form
 $\ln (28\text{-day normalized Si release}) = A + B \cdot x$, where x is the model
parameter, and B is the reported slope.
- (b) The standard errors for these slopes are shown in Table 4.
- (c) Value obtained using the alternative calculator scheme (Appendix A) used
by Jantzen et al.

TABLE 4. Standard Errors of the Slopes of the Best Fit Lines

Model	Standard Error ^(a)			Description of Model
	Slope for All Glasses	Slope for Waste Glasses	Slope for SRL Glasses	
Standard free energy of hydration	0.07 ^(b)	0.69	0.15	Assumes independent glass constituents and hydration reactions. Does not depend on solution effects such as pH.
pH-corrected free energy of hydration	0.05 ^(b)	0.54	0.13	Same as the standard free energy model, but includes pH effects.
NBO	0.11	0.58	0.16	A measure of the degree of crosslinking for a glass matrix
Valence-oxygen	0.06	1.07	0.17	An empirical model to eliminate discrepancies between the free energy and NBO models.

(a) The standard error is the absolute value of (reported error of slope)/(slope).

(b) Value obtained using alternative calculation scheme (Appendix A) used by Jantzen et al.

FIGURE 8. Natural Log of 28-Day Normalized Silica Release Plotted Against Nonbridging Oxygens for a Set of Waste Glasses

FIGURE 9. Natural Log of 28-Day Normalized Silica Release Plotted Against Nonbridging Oxygens for a Set of Savannah River Glasses

FIGURE 10. Natural Log of 28-Day Normalized Silica Release Plotted Against Valence Parameter for all Reported Glasses

FIGURE 11. Natural Log of 28-Day Normalized Silica Release Plotted Against Valence Parameter for a Set of Waste Glasses

FIGURE 12. Natural Log of 28-Day Normalized Silica Release Plotted Against Valence Parameter for a Set of Savannah River Glasses

FIGURE 15. Natural Log of 25-0w Normalized Stress Ratio ($\ln \sigma$) versus Volume (cm³) for 25-0w Normalized Stress Ratio.

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APPENDIX A

PROCEDURE FOR CALCULATION OF THE FREE ENERGY OF HYDRATION

APPENDIX A

PROCEDURE FOR CALCULATION OF THE FREE ENERGY OF HYDRATION

The following is the procedure for calculating the free pH-adjusted energy of hydration:

1. Obtain the weight percentages of each oxide.
2. Divide each percentage by the molecular weight of that oxide.
3. Calculate the moles of orthosilicates that are present. Oxides of the forms R_2O , RO , and ZrO_2 are assumed to be in the form R_2SiO_3 , $RSiO_3$ and $ZrSiO_4$, respectively. Subtract one mole of SiO_2 for each mole of orthosilicate that is formed. All other oxides are assumed to be in the original oxide form (See Table A.1.).
4. Calculate the total number of moles per 100 g of glass by summing the moles calculated in Step 3.
5. Divide each mole calculation of Step 3 by the result of Step 4 to get the appropriate mole fractions.
6. Multiply each mole fraction by the free energy of hydration for that species (see Table A.1.).
7. Sum the contributions of each constituent. This is the standard free energy of hydration for the glass.
8. Add a free energy contribution

$$\Delta G = 1.364 \left(-\log \left(1 + \frac{10^{-10}}{10^{-pH}} + \frac{10^{-21.994}}{10^{-2pH}} \right) \right)$$

for the dissociation of silicic acid (Jantzen 1986) to the results of Step 7.

TABLE A.1. Free Energy Calculations for PNL 76-68

Component	Molecular Weight	Standard Free Energy of Hydration, kcal/mole	Oxide, wt%	Oxide, Moles/100 g	Component, Moles/100 g	Component, Mole Fraction	Free Energy Contribution, kcal/mole	Jantzen's Energy Contribution, kcal/mole
Al ₂ O ₃	101.96	3.04	0.6	0.005884	0.005884	0.006383	0.019406	0.014772
B ₂ O ₃	69.6204	-9.93	8.81	0.126543	0.126543	0.137278	-1.36317	-1.03765
BaO	153.3394	-30.57	0.53	0.003456	0.003456	0.003749	-0.11462	-0.08725
CaO	56.0794	-16.116	2.36	0.042083	0.042083	0.045653	-0.73574	-0.56005
Cr ₂ O ₃	151.9974	37.36	0.15	0.000986	0.000986	0.001070	0.039996	0.030445
Cs ₂ O	281.8094	-46.82	1.02	0.003619	0.003619	0.003926	-0.18383	-0.13994
FeO	71.8464	-14.609	1.95	0.027141	0.027141	0.29443	-0.43014	-0.32742
Fe ₂ O ₃	159.6922	15.5	7.23	0.045274	0.045274	0.049115	0.761288	0.579498
K ₂ O	94.2034	-41.735	0.13	0.001379	0.001379	0.001497	-0.06247	-0.04756
Li ₂ O	29.8774	-22.74	0	0	0	0	0	0
MgO	40.3114	-13.888	0.15	0.003721	0.003721	0.004036	-0.05606	-0.04267
MnO	70.9374	-14.871	0.05	0.000704	0.000704	0.000764	-0.01137	-0.00865
Na ₂ O	61.979	-28.815	11.53	0.186030	0.186030	0.201812	-5.81522	-4.42659
Nd ₂ O ₃	336.4782	-28.32	6.82	0.020268	0.020268	0.021988	-0.62270	-0.47400
NiO	74.7094	-14.347	0.25	0.003346	0.003346	0.003630	-0.05208	-0.03964
P ₂ O ₅	141.937	-52.62	0.74	0.005213	0.005213	0.005655	-0.29761	-0.22654
PbO	223.19	-8.81	0	0	0	0	0	0
SiO ₂	60.0848	5.59	40.84	0.679706	0.390535	0.423665	2.368290	1.802760
SrO	103.6194	-24.4	0.42	0.004053	0.004053	0.004397	-0.10729	-0.08167
ThO ₂	264	-2.533	0	0	0	0	0	0
TiO ₂	79.8988	15.99	3.03	0.037922	0.037922	0.041140	0.657830	0.500745
UO ₂	270.0388	-6.8	0	0	0	0	0	0
ZrO ₂	123.2188	45.1	1.68	0.013634	0.013634	0.014790	0.667070	0.507779
Totals			88.29	1.210971	0.921800	1	-5.33847	-4.06368
							Sum+pH S1-5.60399	Sum+pH S1-4.32921
							Sum+pH B -6.52318	Sum+pH B -5.24839
							pH= 9.75	pH= 9.75

9. Add a free energy contribution

$$\Delta G = 1.364 \left(-\log \left(1 + \frac{10^{-9.18}}{10^{-\text{pH}}} + \frac{10^{-21.89}}{10^{-2\text{pH}}} + \frac{10^{-35.69}}{10^{-3\text{pH}}} \right) \right)$$

for the dissociation of boric acid (Jantzen 1986) to the results of Step 8. The result is the free energy of hydration. Do not include Step 9 if no B_2O_3 is present in the glass.

Free energy calculations for the waste glass PNL 76-68 are shown in Table A.1.

This calculation procedure was not identical to that used by Jantzen and Plodinec. Their method of calculating the free energy is:

1. Obtain the weight percentages of each oxide.
2. Divide each percentage by the molecular weight of that oxide.
3. Calculate the moles of orthosilicates that are present. Oxides of the forms R_2O , RO , and ZrO_2 are assumed to be in the form R_2SiO_3 , RSiO_3 and ZrSiO_4 , respectively. All other oxides are assumed to remain in their original oxide form.
4. Calculate the total number of oxide moles per 100 g of glass by summing the moles calculated in Step 2.
5. Subtract the total number of moles of R_2SiO_3 , RSiO_3 and ZrSiO_4 from the moles of SiO_2 .
6. Divide each mole calculation of Steps 3 and 5 by the result of Step 4.
7. Multiply each value of Step 6 by the corresponding free energy of hydration for that species.
8. Sum the contributions of each constituent. This is the standard free energy of hydration for the glass.

9. Add a free energy contribution

$$\Delta G = 1.364 \left(-\log \left(1 + \frac{10^{-10}}{10^{-\text{pH}}} + \frac{10^{-21.994}}{10^{-2\text{pH}}} \right) \right)$$

for the dissociation of silicic acid (Jantzen 1986) to the results of Step 8.

10. Add a free energy contribution

$$\Delta G = 1.364 \left(-\log \left(1 + \frac{10^{-9.18}}{10^{-\text{pH}}} + \frac{10^{-21.89}}{10^{-2\text{pH}}} + \frac{10^{-35.69}}{10^{-3\text{pH}}} \right) \right)$$

for the dissociation of boric acid (Jantzen 1986) to the results of Step 9. This is the free energy of hydration. Do not include this term if no B_2O_3 is present in the glass.

Newton, Paul, and Jantzen's procedure calculates each mole fraction by dividing the number of moles of a glass constituent by the total number of moles of original oxides (Table 1). In this report, each mole fraction is calculated by dividing the number of moles of a constituent by the total number of moles of glass constituents. Newton, Paul, and Jantzen normalize by the raw materials, but this report normalizes by the glass component species. The hydration energy is based on the glass composition species.

The natural log of 28-day normalized silica release is plotted against the free energy of hydration for some representative glass data (Figure A.1) to show how the results of the two calculation procedures differ. The plot shows that for the more resistant glasses (those with comparatively positive energies of hydration) the two procedures calculate very similar hydration energy values. For the less durable glasses (those with negative hydration energies which "drive" the dissolution process) the calculated hydration energies do differ. However, the same qualitative observations are made using either calculation procedure.

FIGURE A.1. Natural Log of 28-Day Normalized Silica Release Plotted Against pH-Adjusted Free Energy of Hydration for Representative Glass Data. The trends are similar despite slight differences in methods of calculation.

REFERENCE

Jantzen, C. M. 1986. Prediction of Nuclear Waste Glass Durability from Natural Analogs. DP-MS-86-95, E. I. DuPont De Nemours, Inc., Aiken, South Carolina

FIGURE 1. The number of hybrid seedlings (Y-axis) versus the number of hybrid seedlings (X-axis) for the number of hybrid seedlings (X-axis) and the number of hybrid seedlings (Y-axis). The number of hybrid seedlings (X-axis) and the number of hybrid seedlings (Y-axis) are shown in the legend.

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APPENDIX B

PROCEDURE FOR CALCULATION OF THE VALENCE PARAMETER

APPENDIX B

PROCEDURE FOR CALCULATION OF THE VALENCE PARAMETER

The following is a description of the procedure used to calculate the valence parameter of Equation (4):

1. Obtain the weight percentages of each oxide.
2. Divide each percentage by the molecular weight of the corresponding oxide.
3. Sum the results of Step 2.
4. Divide the results of Step 2 by the result of Step 3 to get the mole fractions of the oxides.
5. Each oxide is of the form R_jO_x . Multiply the mole fractions obtained in Step 4 by the value of x corresponding to each oxide.
6. Sum the results of Step 5. This is the moles of oxygen atoms per mole of oxides.
7. Multiply the mole fractions of any oxides of the form R_2O from Step 5 by 3 and sum the results.
8. All other oxides of the form R_jO_x are multiplied by $(-x)$. Sum these results.
9. Add the results of Steps 7 and 8 and divide that result by the result of Step 6. This is the valence parameter.

Valence parameters for the waste glass PNL 76-68 are shown in Table B.1.

TABLE B.1. Spreadsheet of Valence Parameter Calculations for PNL 76-68

Component	Molecular Weight	Oxygen Coefficient	Valence Coefficient	Oxide, wt%	Oxide, Mole/100 g	Oxide, Mole Fraction	Valence Parameter Contribution Factor	Oxygen Contribution Factor
Al ₂ O ₃	101.96	3	-3	0.6	0.005884	0.004859	-0.01457	0.014578
B ₂ O ₃	69.6204	0	0	8.81	0.126543	0.104497	0	0
BaO	153.3394	1	-1	0.53	0.003456	0.002854	0.00285	0.002854
CaO	56.0794	1	-1	2.36	0.042083	0.034751	-0.03475	0.034751
Cr ₂ O ₃	151.9974	3	-3	0.15	0.000986	0.000814	-0.00244	0.002444
Cs ₂ O	281.8094	1	3	1.02	0.003619	0.002988	0.008966	0.002988
FeO	71.8464	1	-1	1.95	0.027141	0.022412	-0.2241	0.022412
Fe ₂ O ₃	159.6922	3	-3	7.23	0.045274	0.037387	-0.11216	0.112161
K ₂ O	94.2034	1	3	0.13	0.001379	0.001139	0.003418	0.001139
Li ₂ O	29.8774	1	3	0	0	0	0	0
MgO	40.3114	1	-1	0.15	0.003721	0.003072	-0.00307	0.003072
MnO	70.9374	1	-1	0.05	0.000704	0.000582	-0.00058	0.000582
Na ₂ O	61.979	1	3	11.53	0.186030	0.153621	0.460863	0.153621
Nd ₂ O ₃	336.4782	3	-3	6.82	0.020268	0.016737	-0.05021	0.050212
NiO	74.7094	1	-1	0.25	0.003346	0.002763	-0.00276	0.002763
P ₂ O ₅	141.937	5	-5	0.74	0.005213	0.004305	-0.02152	0.021526
PbO	223.19	1	-1	0	0	0	0	0
SiO ₂	60.0848	2	-2	40.84	0.679706	0.561289	-1.12257	1.122579
SrO	103.6194	1	-1	0.42	0.004053	0.003347	-0.00334	0.003347
ThO ₂	264	2	-2	0	0	0	0	0
TiO ₂	79.8988	2	-2	3.03	0.037922	0.031316	-0.06263	0.062632
UO ₂	270.0388	2	-2	0	0	0	0	0
ZrO ₂	123.2188	2	-2	1.68	0.013634	0.011258	-0.02251	0.022517
Totals				88.29	1.210971	1	-1.00518	1.636182

Valence
Parameter -0.61434

APPENDIX C

GLASS COMPOSITION DATA AND MODEL PARAMETERS

APPENDIX C

GLASS COMPOSITION DATA AND MODEL PARAMETERS

- The compositions listed in Appendix C are the un-normalized weight percentages of the oxides.
- 28-d NSi is the 28-day normalized Si release at 90°C in distilled H₂O for a S/V of 10 m⁻¹.
- pH is the measured pH after 28 days.
- St. G_{hyd} is the standard free energy of hydration of the glass (kcal/mole).
- Jantzen's G_{hyd} is the standard free energy of hydration (kcal/mole) calculated using Jantzen and Plodinec's procedure (1984).
- G_{hyd} is the pH corrected free energy of hydration (kcal/mole).
- Jantzen's G_{hyd} is the pH corrected free energy of hydration (kcal/mole) calculated with Jantzen and Plodinec's procedure (1984).
- NBO is the fraction of nonbridging oxygens calculated with Equation (4), from Jantzen and Plodinec (1984).
- Val. Par. is the valence-oxygen parameter, P, as calculated in Appendix B.
- Data 1 through 149 were obtained from C. M. Jantzen of SRL.
- Data 150 through 192 were obtained from S. O. Bates of PNL.
- Data 193 through 293 were obtained from Chick et al. (1984).
- Data point 294 was obtained from D. M. Strachan of PNL.
- Data point 295 was obtained from L. R. Eisenstatt of West Valley Nuclear Services Co.
- Data point 296 was obtained from Konnecke and Kirsch (1985).
- Data point 297 was obtained from Strachan, Pederson, and Lokken (1985).
- The title of the data base file is listed in the upper left hand corner of the pages of Appendix C.

- Data points 53, 58, 126, 129, 149, 198, 202, 214, 229, 247, 267, and 277 were not included in the free energy model calculations. The compositions of these glasses lead to a negative mole fraction of SiO_2 . This limitation is inherent in the free energy calculation used in this report (Appendix A) when applied to "silica-depleted" glasses.
- The data base is located on the BWIP MicroVax II computer system located in the 3764 Building.
- SRL glasses include glasses 10-49. Waste glasses include glasses 1-9 and 294-297.

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- Strachan D. M., L. R. Pederson, and R. O. Lokken. 1985. Results from the Long-Term Interaction and Modeling of SRL-131 Glass with Aqueous Solutions. PNL-5654, Pacific Northwest Laboratory, Richland, Washington.

Ø Glass	1 Al2O3	2 CaO	3 Fe2O3	4 FeO	5 MgO	6 MnO	7 Na2O	8 Li2O	9 NiO	10 SiO2	11 Cr2O3
1 M2	8.8800	0.0000	2.6900	0.7300	0.0000	0.9200	14.8300	0.0000	0.540000	43.9800	0.000000
2 M3	4.2000	4.2500	1.0900	0.3000	0.3800	0.7900	13.6700	0.0000	0.470000	52.9900	0.000000
3 M4	5.0800	0.0000	1.8200	0.4900	0.0000	1.1300	9.1200	0.0000	0.670000	47.2800	0.000000
4 M5	3.1100	2.0800	2.0000	0.6400	0.0000	0.8900	12.9800	2.0800	0.520000	51.9000	0.000000
5 M6	2.0800	3.9000	2.0000	0.5400	0.0000	0.8900	11.7100	0.0000	0.520000	50.2400	0.360000
6 MCC 76-88	0.6000	2.3600	7.2300	1.9500	0.1500	0.0500	11.5300	0.0000	0.260000	40.8400	0.150000
7 AECL	19.1000	18.8000	2.1500	0.5800	0.4000	0.0000	11.7000	0.0000	0.200000	48.3000	0.400000
8 JAP GB7	4.8371	1.1641	7.1400	1.9300	0.0758	0.2376	8.4789	1.9394	1.265000	50.0596	0.461900
9 JAP G2	6.7266	1.9589	6.8800	1.8600	0.0688	0.2834	8.4250	3.1427	0.500000	45.7810	0.445800
10 131AT30%	3.3690	1.2030	10.9200	2.9500	2.2800	3.3200	13.6700	3.9900	4.060000	43.8700	0.000000
11 105 BLACK	4.5000	1.7400	5.5300	4.9200	0.6900	1.6700	9.9700	5.1700	0.990000	53.1800	0.000000
12 131AT50%	5.6200	2.0000	18.2000	4.9200	1.0000	5.5500	10.9900	2.8500	2.900000	34.5200	0.000000
13 185MM	3.9800	1.4900	8.3700	2.2600	0.7100	2.8800	11.5500	5.1000	0.770000	54.4200	0.000000
14 SRLS2	5.0300	1.5800	9.9100	2.6800	0.7200	3.5700	13.6400	0.0000	1.000000	46.4300	0.000000
15 SRLS12	7.5500	2.3700	14.8400	4.0100	0.5800	6.3500	3.2000	8.2500	1.820000	39.6400	0.000000
16 SRLS15	7.5500	2.3700	14.8400	4.0100	0.5800	6.3500	5.9500	8.2500	1.820000	47.8900	0.000000
17 SRLS17	5.0300	1.5800	9.9900	2.6700	0.7200	3.5700	10.4900	5.2500	1.000000	51.6800	0.000000
18 SRL 108	4.8650	1.5300	9.5600	2.5900	0.7300	3.4500	10.2300	4.2600	1.040000	48.3000	0.000000
19 SRL 168	4.8650	1.5300	9.5600	2.5900	0.7300	3.4500	10.2300	4.2600	1.040000	48.3000	0.000000
20 TNX165	0.0000	2.1128	9.0400	2.4400	0.7031	1.7689	6.7939	4.3050	1.024400	52.0793	0.049700
21 106AL	10.2222	1.4272	5.8475	1.5824	0.8723	1.4591	8.5483	4.0252	0.979900	52.9263	0.190000
22 SRL131TDS	10.7702	1.6251	8.9499	2.4186	1.4328	2.4533	9.1260	3.1642	0.959500	44.3263	0.176900
23 SRL106AL	10.2279	1.4272	5.8332	1.5747	0.8723	1.4591	8.5483	4.0252	0.979900	52.9263	0.190000
24 SRL131FE	3.5145	1.1501	12.5385	3.3835	1.3268	3.3055	14.6932	4.0252	2.112500	35.7263	0.233900
25 SRL165TDS	6.0464	1.8190	10.2224	2.7647	0.9684	2.2725	9.0181	4.3265	1.259900	52.0000	0.204600
26 SRL165TDS	6.0464	1.8190	10.2224	2.7647	0.9684	2.2725	9.0181	4.3265	1.259900	52.0000	0.204600
27 SRL131AL	11.1858	1.8749	6.7482	1.8288	1.8075	1.6269	9.9213	3.9178	1.005400	47.9203	0.204600
28 SRL131FE	3.5145	1.1501	12.5328	3.3835	1.3268	3.3055	14.6932	4.0252	2.112500	35.7263	0.233900
29 SRL131AL	11.1858	1.8749	6.7482	1.8288	1.8075	1.6269	9.9213	3.9178	1.005400	47.9203	0.204600
30 SRL131TDS	7.3502	1.4692	5.8618	1.5824	1.4593	1.4591	14.4236	3.5732	1.005400	44.0896	0.263100
31 SRL165FE	2.6097	1.1613	11.8808	3.2034	0.8789	2.5604	14.8280	3.9391	1.272600	47.4925	0.219200
32 SRL131TDS	7.3502	1.4692	5.8761	1.5824	1.4593	1.4591	14.4236	3.5732	1.005400	44.0896	0.263100
33 AH1	4.1900	1.3200	9.0000	2.4300	0.6300	2.0240	11.7600	4.4000	0.930000	47.4800	0.000000
34 AH2	4.4400	0.8400	9.0000	2.4300	0.6400	2.6200	11.2300	3.8400	0.980000	42.6500	0.000000
35 AH3	4.1900	1.3200	9.0000	2.4300	1.2600	2.0240	10.6100	3.1400	0.930000	48.7400	0.000000
36 AH4	4.1900	1.3200	9.0000	2.4300	0.7000	2.0240	10.0000	4.0000	0.930000	52.0000	0.000000
37 AH5	4.4400	0.8400	8.8900	2.4000	0.6400	2.6200	9.3100	3.8400	0.980000	51.6100	0.000000
38 AH6	4.4400	0.8400	8.8900	2.4000	0.6400	2.6200	11.2300	4.4800	0.980000	46.4800	0.000000
39 AH7	4.4400	0.8400	8.8900	2.4000	0.6400	2.6200	9.3100	3.2000	0.980000	47.7700	0.000000
40 AH8	4.4400	0.8400	8.8900	2.4000	1.2800	2.6200	9.9500	3.2000	0.980000	47.7700	0.000000
41 AH9	4.4400	0.8400	8.8900	2.4000	0.6400	2.6200	9.3100	3.5200	0.980000	49.6900	0.000000
42 AH10	4.4400	0.8400	8.8900	2.4000	1.2800	2.6200	6.7500	4.4800	0.980000	52.2500	0.000000
43 AH11	4.4400	0.8400	8.8900	2.4000	1.2800	2.6200	6.7500	3.8400	0.980000	48.4100	0.000000
44 AH12	5.5000	1.7200	11.1200	3.0000	0.5700	3.2900	10.4700	3.3900	1.230000	38.7600	0.000000
45 AH13	5.5000	1.7200	11.1200	3.0000	0.5700	3.2900	8.7700	3.3900	1.230000	46.6700	0.000000
46 AH14	5.5000	1.7200	11.1200	3.0000	0.5700	3.2900	10.4700	3.9600	1.230000	42.1500	0.000000
47 AH15	5.5000	1.7200	11.1200	3.0000	1.1300	3.9600	9.3400	2.8300	1.230000	43.2800	0.000000
48 AH131	4.2600	0.8400	8.8900	2.4000	1.4400	2.6200	13.5900	4.1000	0.980000	44.6800	0.000000
49 AH165	4.2600	0.8400	8.8900	2.4000	0.7200	2.6200	10.2100	5.0400	0.980000	51.9300	0.000000
50 ESF161	3.9000	19.0000	0.3000	0.0000	3.2000	0.5000	5.0000	0.0000	0.000000	56.0000	0.000000
51 ESF77-33	4.1000	22.6000	2.5000	0.0000	0.0500	0.0500	21.7000	0.0000	0.000000	48.7000	0.000000
52 ESF144	3.9000	20.6000	2.1000	0.0000	0.0400	0.0500	0.1000	0.0000	0.000000	43.8000	0.000000
53 ESF168	3.8000	28.4000	0.0000	0.0000	0.0600	0.1000	0.1000	0.0000	0.100000	42.6000	0.000000
54 ESF147	3.8000	30.1000	0.0000	0.0000	0.0500	0.0000	0.1000	0.0000	0.000000	48.7000	0.000000

0 Glass	12 B203	13 U02	14 SrO	15 ZrO2	16 TiO2	17 K2O	18 Cs2O	19 Sb2O3	20 P2O5	21 Nd2O3
1 M2	18.3300	0.000000	0.380000	1.880000	0.0000	0.000000	1.280000	0.0000	0.000000	4.650000
2 M3	14.0500	0.000000	0.000000	0.330000	1.6100	0.000000	1.110000	0.0000	0.000000	4.020000
3 M4	22.8100	0.000000	0.480000	2.340000	0.0000	0.000000	1.620000	0.0000	0.000000	5.860000
4 M5	14.9800	0.000000	0.360000	1.810000	0.0000	0.000000	1.250000	0.0000	0.000000	4.510000
5 M6	19.1700	0.000000	0.000000	1.810000	0.0000	0.000000	1.250000	0.0000	0.000000	4.510000
6 MCC 76-68	8.8100	0.000000	0.420000	1.680000	3.0300	0.130000	1.020000	0.0000	0.740000	6.820000
7 AECL	0.0000	1.100000	0.100000	0.000000	0.2000	3.900000	0.010000	0.0000	0.000000	0.000000
8 JAP QB7	9.2739	0.000000	0.385400	2.120800	0.0310	1.000000	0.042400	0.0000	0.000000	6.100000
9 JAP Q2	9.4671	0.189400	0.415100	2.120800	0.0259	2.084000	1.000000	0.0000	0.000000	6.100000
10 131AT30%	10.2900	0.000000	0.000000	0.350000	0.7000	0.000000	0.000000	0.0000	0.000000	0.350000
11 165 BLACK	7.3000	1.060000	0.080000	0.670000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
12 131AT50%	7.3500	0.000000	0.000000	0.250000	0.5000	0.000000	0.000000	0.0000	0.000000	0.500000
13 165MM	7.1400	0.000000	0.100000	0.710000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
14 SRLS2	14.0000	0.000000	0.000000	0.700000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
15 SRLS12	11.0000	0.000000	0.000000	0.550000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
16 SRLS15	0.0000	0.000000	0.000000	0.550000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
17 SRLS17	6.6500	0.000000	0.000000	0.700000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
18 SRL 168	12.0700	0.000000	0.000000	0.710000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
19 SRL 168	12.0700	0.000000	0.000000	0.710000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
20 TNX165	7.2774	0.000000	0.013000	0.783500	0.2085	4.613600	0.000000	0.0000	0.000000	0.000000
21 165AL	8.5977	0.864800	0.047300	1.053800	0.0667	0.000000	0.000000	0.0000	0.000000	0.000000
22 SRL131TDS	11.3670	2.132700	0.047300	0.483800	0.7272	0.000000	0.000000	0.0000	0.012600	0.000000
23 SRL165AL	8.5977	0.864800	0.046100	1.053800	0.0667	0.000000	0.000000	0.0000	0.137500	0.000000
24 SRL131FE	12.0754	1.134400	0.071000	0.499800	0.7840	0.000000	0.000000	0.0000	0.000000	0.000000
25 SRL165TDS	8.9841	1.191100	0.059100	0.720000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
26 SRL165TDS	8.9841	1.191100	0.059100	0.720000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
27 SRL131AL	10.1111	0.998300	0.047300	0.540300	0.0834	0.000000	0.000000	0.0000	0.000000	0.000000
28 SRL131FE	12.0754	1.134400	0.071000	0.499800	0.7840	0.000000	0.000000	0.0000	0.000000	0.000000
29 SRL131AL	10.1111	0.998300	0.047300	0.540300	0.0834	0.000000	0.000000	0.0000	0.000000	0.000000
30 SRL131TDS	8.0231	2.132700	0.047300	0.499800	0.8173	0.060200	0.000000	0.0000	0.000000	0.000000
31 SRL165FE	11.5602	0.000000	0.071000	0.553800	0.8006	0.000000	0.137800	0.0000	0.000000	0.000000
32 SRL131TDS	8.0231	2.132700	0.047300	0.499800	0.8173	0.060200	0.000000	0.0000	0.000000	0.000000
33 AH1	8.6500	0.000000	0.040000	0.620000	1.2600	3.190000	0.090000	0.0000	0.000000	0.000000
34 AH2	13.2600	0.000000	0.050000	0.640000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
35 AH3	9.9100	0.000000	0.040000	0.000000	1.2600	3.190000	0.090000	0.0000	0.000000	0.000000
36 AH4	6.9000	0.000000	0.040000	0.000000	1.2600	3.190000	0.090000	0.0000	0.000000	0.000000
37 AH5	8.8600	0.000000	0.050000	0.000000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
38 AH6	8.7800	0.000000	0.050000	0.840000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
39 AH7	11.3400	0.000000	0.050000	0.000000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
40 AH8	10.0600	0.000000	0.050000	0.000000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
41 AH9	9.1000	0.000000	0.050000	0.000000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
42 AH10	7.5000	0.000000	0.050000	0.000000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
43 AH11	11.9800	0.000000	0.050000	0.000000	1.3000	3.200000	0.060000	0.0000	0.000000	0.000000
44 AH12	11.9900	0.000000	0.080000	0.570000	1.3000	3.200000	0.064000	0.0000	0.000000	0.000000
45 AH13	6.3400	0.000000	0.080000	0.570000	1.3000	3.200000	0.064000	0.0000	0.000000	0.000000
46 AH14	8.0300	0.000000	0.080000	0.570000	1.3000	3.200000	0.064000	0.0000	0.000000	0.000000
47 AH15	9.1800	0.000000	0.080000	0.000000	1.3000	3.200000	0.064000	0.0000	0.000000	0.000000
48 AH131	10.5800	0.000000	0.050000	0.360000	2.0200	0.000000	0.060000	0.0000	0.000000	0.350000
49 AH165	7.2000	0.000000	0.050000	0.720000	1.3000	0.000000	0.060000	0.0000	0.000000	0.000000
50 ESF151	0.0000	0.000000	0.000000	0.000000	0.2000	7.200000	0.000000	0.0000	3.900000	0.000000
51 ESF77-33	0.0000	0.000000	0.000000	0.000000	0.1000	0.000000	0.000000	0.0000	0.000000	0.000000
52 ESF144	0.0000	0.000000	0.000000	0.000000	0.1000	29.500000	0.000000	0.0000	0.000000	0.000000
53 ESF158	0.0000	0.000000	0.000000	0.000000	0.0000	24.200000	0.000000	0.0000	0.000000	0.000000
54 ESF147	0.0000	0.000000	0.100000	0.100000	0.5000	14.800000	0.000000	0.0000	0.000000	0.000000

Ø Glass	22 BaO	23 PbO	24 ThO2	25 28-D NSi (g/m**2)	26 pH	27 St. Ghyl (KC/Mol)	28 Jantzen's St. Ghyl	29 Ghyl (KC/Mol)	30 Jantzen's Ghyl
1 M2	0.6700	0.0000	0.000000	7.800000	8.500000	-6.321225	-4.999913	-6.452075	-5.130763
2 M3	0.5800	0.0000	0.000000	4.200000	8.350000	-5.964188	-4.624134	-6.059024	-4.718971
3 M4	0.8400	0.0000	0.000000	10.600000	8.500000	-3.868025	-3.278748	-3.998875	-3.409598
4 M5	0.8400	0.0000	0.000000	9.200000	9.100000	-6.902608	-5.205965	-7.331554	-5.634912
5 M6	0.6400	0.0000	0.000000	14.800000	8.800000	-5.563879	-4.394287	-5.806582	-4.636990
6 MCC 76-68	0.5300	0.0000	0.000000	23.900000	9.750000	-5.344103	-4.067972	-6.528813	-5.252682
7 AECL	0.0000	0.0000	0.000000	16.800000	8.210000	-11.192238	-7.000778	-11.201769	-7.010307
8 JAP GB7	1.7000	0.0000	0.000000	9.000000	7.800000	-4.203543	-3.256540	-4.231463	-3.284460
9 JAP G2	0.7000	0.0000	0.000000	9.860000	7.810000	-6.457007	-4.764680	-6.485568	-4.793238
10 131AT30%	0.0000	0.0000	0.000000	17.160000	9.480000	-11.941445	-7.541239	-12.748283	-8.348076
11 165 BLACK	0.0000	0.0000	0.000000	15.310000	9.500000	-8.236635	-5.640547	-9.068274	-6.472186
12 131AT50%	0.0000	0.0000	0.000000	15.990000	9.390000	-11.182435	-6.955811	-11.883908	-7.657084
13 165MM	0.0000	0.0000	0.000000	13.230000	8.500000	-7.826100	-5.422382	-7.956950	-5.553232
14 SRLS2	0.0000	0.0000	0.000000	16.170000	9.000000	-6.378381	-4.747487	-6.735418	-5.104522
15 SRLS12	0.0000	0.0000	0.000000	26.010000	9.800000	-10.092787	-6.510635	-11.357661	-7.775510
16 SRLS15	0.0000	0.0000	0.000000	18.665000	10.000000	-9.469277	-5.888720	-9.882877	-6.302320
17 SRLS17	0.0000	0.0000	0.000000	22.505000	10.000000	-8.073689	-5.505941	-9.690262	-7.122514
18 SRL 168	0.0000	0.0000	0.000000	18.570000	8.200000	-7.919409	-5.570828	-7.987719	-5.638939
19 SRL 168	0.0000	0.0000	0.000000	19.600000	9.440000	-7.919409	-5.570828	-8.678181	-6.329380
20 TNX165	0.0000	0.0000	0.000000	17.800000	9.840000	-7.589283	-5.328906	-8.660177	-6.660177
21 165AL	0.0000	0.0000	0.000000	7.813582	8.900000	-4.997343	-3.742565	-5.292594	-4.037816
22 SRL131TDS	0.0000	0.0000	0.000000	16.800000	9.850000	-6.501855	-4.741344	-7.850038	-6.089527
23 SRL165AL	0.1583	0.2585	0.000000	8.610000	9.040000	-5.084063	-3.803179	-5.468601	-4.187716
24 SRL131FE	0.0000	0.0000	0.000000	23.770000	9.200000	-13.694880	-8.476764	-14.206655	-8.988539
25 SRL165TDS	0.0000	0.0000	0.000000	13.490000	9.580000	-6.307011	-4.530527	-7.242947	-5.466463
26 SRL165TDS	0.0000	0.0000	0.000000	14.280000	8.850000	-6.307011	-4.530527	-6.574892	-4.798407
27 SRL131AL	0.0000	0.0000	0.000000	13.710000	8.770000	-7.145691	-5.118021	-7.374288	-5.346819
28 SRL131FE	0.0000	0.0000	0.000000	41.950000	9.970000	-13.696042	-8.477355	-15.256761	-10.038073
29 SRL131AL	0.0000	0.0000	0.000000	13.260000	8.970000	-7.145691	-5.118021	-7.483168	-5.455497
30 SRL131TDS	0.0000	0.0000	0.000000	22.230000	9.160000	-9.993477	-6.746491	-10.470765	-7.223779
31 SRL165FE	0.0000	0.0000	0.000000	24.600000	9.100000	-9.811465	-6.610281	-10.240411	-7.039227
32 SRL131TDS	0.0000	0.0000	0.000000	20.490000	9.180000	-9.991168	-6.745131	-10.485470	-7.239433
33 AH1	0.0000	0.0000	0.000000	17.120000	8.770000	-9.758289	-6.805205	-9.986888	-6.833802
34 AH2	0.0000	0.0000	0.000000	16.750000	8.150000	-10.128105	-6.952386	-10.189271	-7.013552
35 AH3	0.0000	0.0000	0.000000	18.830000	8.920000	-8.160782	-5.782137	-8.467601	-6.088976
36 AH4	0.0000	0.0000	0.000000	21.390000	8.880000	-7.640437	-5.405903	-7.913613	-5.679079
37 AH5	0.0000	0.0000	0.000000	15.710000	8.360000	-7.167096	-5.124391	-7.264010	-5.221305
38 AH6	0.0000	0.0000	0.000000	18.730000	8.960000	-9.758062	-6.602320	-10.089218	-6.933475
39 AH7	0.0000	0.0000	0.000000	15.450000	8.350000	-7.526919	-5.460204	-7.621755	-5.655040
40 AH8	0.0000	0.0000	0.000000	18.850000	8.830000	-8.114892	-5.755500	-8.372445	-6.013053
41 AH9	0.0000	0.0000	0.000000	15.590000	8.580000	-7.336647	-5.284382	-7.491516	-5.439252
42 AH10	0.0000	0.0000	0.000000	15.580000	8.840000	-6.603904	-4.758820	-6.866578	-5.021494
43 AH11	0.0000	0.0000	0.000000	16.030000	8.830000	-6.957422	-5.085949	-7.214975	-5.343502
44 AH12	0.0000	0.0000	0.000000	20.750000	8.880000	-10.596784	-7.101001	-10.880816	-7.385033
45 AH13	0.0000	0.0000	0.000000	19.800000	8.910000	-7.599194	-5.275733	-7.900192	-5.576732
46 AH14	0.0000	0.0000	0.000000	20.200000	9.100000	-10.246770	-6.774847	-10.875716	-7.203794
47 AH15	0.0000	0.0000	0.000000	19.480000	8.860000	-6.880356	-6.098159	-9.153532	-6.369335
48 AH131	0.0000	0.0000	0.000000	20.170000	9.640000	-9.856987	-6.637578	-10.875510	-7.657099
49 AH165	0.0000	0.0000	0.000000	15.700000	9.380000	-6.983282	-4.911210	-7.673673	-5.601602
50 ESF151	0.0000	0.7100	0.000000	134.000000	9.940000	-11.536347	-7.281769	-11.909874	-7.655296
51 ESF77-33	0.2000	0.0000	0.000000	84.000000	9.810000	-9.829614	-9.829614	-18.952221	-10.126219
52 ESF144	0.2000	0.0000	0.000000	163.200000	10.750000	-23.812740	-12.064574	-24.960699	-13.812533
53 ESF158	0.0000	0.1400	0.000000	109.000000	10.800000	-25.757894	-12.079098	-26.727851	-13.649054
54 ESF147	0.0000	0.0000	0.000000	95.340000	9.840000	-16.764193	-9.234661	-17.077369	-9.547837

Ø Glass	31 NBO	32 Val. Per.	33
1 M2	0.350975	-0.547293	2.054124
2 M3	0.490406	-0.813601	1.435085
3 M4	0.318055	-0.700556	2.380854
4 M5	0.507374	-0.502988	2.219203
5 M6	0.460016	-0.638877	2.894827
6 MCC 76-88	0.846190	-0.814348	3.173878
7 AECL	0.519680	-0.865353	2.809403
8 JAP GB7	0.435280	-0.636526	2.203069
9 JAP G2	0.486025	-0.535815	2.288486
10 131AT30%	0.637443	-0.401139	2.842581
11 165 BLACK	0.546744	-0.468438	2.728506
12 131AT50%	0.538091	-0.503276	2.771964
13 165MM	0.506313	-0.446229	2.582487
14 SRLS2	0.366379	-0.610166	2.783158
15 SRLS12	0.498920	-0.446038	3.219278
16 SRLS15	0.546576	-0.445749	2.926650
17 SRLS17	0.501100	-0.460410	3.113738
18 SRL 168	0.461129	-0.485904	2.921547
19 SRL 168	0.461129	-0.485904	2.975530
20 TNX165	0.535616	-0.485039	2.879198
21 165AL	0.350186	-0.578897	2.055864
22 SRL131TDS	0.379276	-0.578735	2.821379
23 SRL165AL	0.352230	-0.578011	2.152924
24 SRL131FE	0.656721	-0.297437	3.188424
25 SRL165TDS	0.429572	-0.546407	2.601949
26 SRL165TDS	0.429572	-0.546407	2.658860
27 SRL131AL	0.393073	-0.535017	2.618125
28 SRL131FE	0.656787	-0.297401	3.736478
29 SRL131AL	0.393073	-0.535017	2.584752
30 SRL131TDS	0.563400	-0.390074	3.101443
31 SRL165FE	0.563250	-0.387220	3.202746
32 SRL131TDS	0.563243	-0.390145	3.019937
33 AH1	0.566038	-0.381331	2.840247
34 AH2	0.543141	-0.380759	2.818398
35 AH3	0.495384	-0.482033	2.935451
36 AH4	0.498382	-0.473008	3.062924
37 AH5	0.481164	-0.494437	2.754297
38 AH6	0.564858	-0.382952	2.930127
39 AH7	0.459034	-0.488835	2.737609
40 AH8	0.491851	-0.488861	2.938513
41 AH9	0.469958	-0.496878	2.748830
42 AH10	0.470855	-0.529846	2.744704
43 AH11	0.448814	-0.536486	2.710048
44 AH12	0.538790	-0.416233	3.032546
45 AH13	0.492433	-0.519098	2.985682
46 AH14	0.558227	-0.416536	3.005683
47 AH15	0.501017	-0.513048	2.969388
48 AH131	0.599362	-0.397594	3.004196
49 AH165	0.516612	-0.489483	2.753661
50 ESF151	0.893351	-0.768313	4.897840
51 ESF77-33	0.885765	-0.460259	4.430817
52 ESF144	0.889492	-0.450932	5.094976
53 ESF158	0.968351	-0.550348	4.691348
54 ESF147	0.867402	-0.743549	4.557449

0 Glass	1 Al2O3	2 CaO	3 Fe2O3	4 FeO	5 MgO	6 MnO	7 Na2O	8 Li2O	9 NiO	10 SiO2	11 Cr2O3
55 ESF148	3.9000	25.9000	0.4000	0.0000	0.0500	0.2000	0.1000	0.0000	0.000000	53.8000	0.000000
56 ESF149	4.2000	21.6000	0.0000	0.0000	0.0500	1.8000	0.1000	0.0000	0.000000	56.8000	0.000000
57 ESF150	4.3000	21.9000	0.3000	0.0000	0.6000	0.0000	0.5000	0.0000	0.000000	55.4000	0.000000
58 ESF159	3.9000	34.9000	0.1000	0.0000	0.0700	1.0000	0.0000	0.0000	0.000000	44.0000	0.000000
59 A&T	12.2062	2.4626	0.0000	5.5062	1.9236	0.1291	1.6985	0.0215	0.000000	69.3133	0.000000
60 CORNING	12.1873	2.7144	0.0000	1.4666	1.8739	0.0000	4.4349	0.0000	0.000000	74.4476	0.000000
61 OBSIDIAN	0.0000	1.3992	0.0000	5.1460	0.2487	0.0904	1.4424	0.0000	0.000000	73.5919	0.000000
62 CORNING	12.1873	2.7144	0.0000	1.4666	1.8739	0.0000	4.4349	0.0000	0.000000	74.4476	0.000000
63 RRL2-3134	13.0564	3.6379	0.0000	9.8000	0.5588	0.2415	3.0734	0.0000	0.000000	59.4725	0.000000
64 OBSIDIAN	0.0000	1.3992	0.0000	5.7090	0.2487	0.0904	1.4424	0.0000	0.000000	73.5919	0.000000
65 GQU	12.4329	16.3912	0.0000	12.4405	4.3282	0.1046	0.8897	0.0215	0.137400	44.2835	0.019400
66 GQT	13.6989	16.6505	0.0000	12.9937	4.7593	1.0794	1.0339	0.0000	0.000000	54.5522	0.013200
67 GQQ	13.1887	5.8626	0.0000	6.2267	21.2262	0.0551	0.1591	0.1464	0.056000	48.3482	0.022900
68 GQN	13.0376	5.8766	0.0000	5.4162	4.4774	0.0439	0.8201	0.0151	0.025500	68.8855	0.019000
69 DQH	18.1014	8.8290	8.0064	0.0000	2.9684	0.1214	1.6176	0.0215	0.015300	61.4407	0.020500
70 DQF	12.5833	4.4746	3.9600	0.0000	0.6981	0.0516	6.0000	0.0431	0.025500	72.3511	0.023400
71 GRF	0.4850	10.9837	0.0000	16.5959	6.5669	0.1240	0.2831	0.0431	0.294000	45.2034	0.031300
72 SILICA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000000	100.0000	0.000000
73 SILICA GLASS	0.3904	0.8464	0.0000	0.8762	0.1415	0.1394	0.0310	0.0000	0.082100	93.0168	0.063400
74 PYREX 7740	2.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000	0.0000	0.000000	81.0000	0.000000
75 PYREX CMJ	2.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000	0.0000	0.000000	81.0000	0.000000
76 WINDOW	0.6000	13.1000	0.0000	0.0000	1.7000	0.0000	13.9000	0.0000	0.000000	70.8000	0.000000
77 PB GLASS	4.2136	1.5111	9.0071	0.0000	0.0000	2.8019	0.0000	9.0836	0.000000	50.7014	0.000000
78 NBS	3.5800	0.1400	0.1000	0.0000	0.0000	0.0000	2.6800	0.4600	0.000000	66.5200	0.000000
79 LIBYAN DESSERT	0.0000	0.8115	0.0000	1.9040	0.0663	0.0258	0.1078	0.1937	0.003800	92.4178	0.056500
80 CUA	0.7900	1.0500	7.1100	9.4200	0.0000	4.0000	2.3000	0.0000	2.090000	59.0000	0.000000
81 FRIT 131	0.0000	0.0000	0.0000	0.0000	2.0000	0.0000	17.7000	5.7000	0.000000	57.9000	0.000000
82 FRIT21	0.0000	4.2000	0.0000	0.0000	2.1000	0.0000	17.2000	3.6000	0.000000	52.5000	0.000000
83 FRIT211	0.0000	5.6000	0.0000	0.0000	0.0000	0.0000	20.6000	4.4000	0.000000	58.3000	0.000000
84 FRIT153	0.0000	0.0000	0.0000	0.0000	2.0000	0.0000	13.5000	4.5000	0.000000	67.0000	0.000000
85 FRIT S15	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	8.0000	15.0000	0.000000	75.0000	0.000000
86 FRIT 168A	1.2524	0.8716	0.3431	0.0000	0.9711	0.0000	12.4016	5.9840	0.176200	59.3442	0.000000
87 FRIT S12	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	3.0000	15.0000	0.000000	60.0000	0.000000
88 FRIT S2	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	18.0000	0.0000	0.000000	60.0000	0.000000
89 FRIT165	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	13.0000	7.0000	0.000000	68.0000	0.000000
90 FRIT 168	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	13.0000	6.0000	0.000000	62.0000	0.000000
91 FRIT 165	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	13.0000	7.0000	0.000000	68.0000	0.000000
92 FRIT S17	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	13.5000	7.5000	0.000000	67.5000	0.000000
93 UMTANUM	12.0550	7.8075	0.0000	14.1515	3.9833	0.2479	4.7989	0.0000	0.131100	46.2089	0.022400
94 LLNL529	28.3800	6.3000	0.0000	4.8700	0.0000	1.6500	12.6200	0.0000	0.000000	36.6600	0.000000
95 BGC-50	12.0000	5.5000	6.9210	1.8700	2.5000	0.0000	9.0000	0.0000	0.000000	55.0000	0.000000
96 HANFORD BASALT	13.0900	9.4700	0.0000	9.6800	5.7500	0.1700	4.6800	0.0000	0.000000	46.8500	0.030000
97 SPODUMENE GL CERAM	21.5403	0.5597	0.2145	0.0000	0.0332	0.0000	0.1618	4.1328	0.356300	65.8904	0.000000
98 SPODUMENE GLASS	21.5403	0.5597	0.2145	0.0000	0.0332	0.0000	0.1618	4.1328	0.356300	65.8904	0.000000
99 POMONA	14.3791	11.0537	0.0000	12.8849	6.7659	0.2208	1.8468	0.0000	0.124200	50.4875	0.229500
100 STRIPA GRANITE	13.3399	0.8297	0.0000	1.6725	0.1973	0.0414	4.0170	0.0215	0.224000	71.6666	0.037100
101 CHASSET	13.1320	7.8956	0.0000	16.5959	3.4658	0.2724	3.1543	0.0000	0.103000	54.1243	0.020000
102 GRANITE	12.9053	0.8647	0.0000	1.6210	0.3400	0.0471	3.4104	0.0265	0.011500	71.2387	0.013200
103 MCCOY CANYON	13.1131	8.4792	0.0000	13.7658	4.2618	0.2621	2.9386	0.0000	0.190900	51.1293	0.033600
104 UMTANUM	12.0550	7.8075	0.0000	14.1515	3.9633	0.2479	2.3994	0.0000	0.131100	46.2089	0.022400
105 NEPHELINE SYENITE	30.8744	2.8544	0.3360	0.3023	0.0332	0.0205	12.9138	0.0136	0.000000	47.9203	0.000000
106 P-16F	16.2000	15.6000	1.5000	1.5000	3.2500	0.0000	4.9800	0.0000	0.000000	53.6000	0.000000
107 P-1	12.2000	5.2000	4.1000	3.7000	0.0000	2.2000	18.0000	0.0000	0.600000	52.3000	0.000000
108 P-3	8.4000	4.6000	5.4000	4.8000	0.0000	2.3000	16.0000	0.0000	1.300000	49.2000	0.000000

0 Glass	12 B203	13 U02	14 SrO	15 ZrO2	16 TiO2	17 K2O	18 Cs2O	19 Sb2O3	20 P2O5	21 Nd2O3
55 ESF148	0.0000	0.000000	0.000000	0.000000	0.0000	14.600000	0.000000	0.0000	0.000000	0.000000
56 ESF149	0.0000	0.000000	0.000000	0.000000	0.2000	14.300000	0.000000	0.0000	0.000000	0.000000
57 ESF150	0.0000	0.000000	0.000000	0.000000	0.0000	1.500000	0.000000	0.0000	0.000000	0.000000
58 ESF159	0.0000	0.000000	0.000000	0.000000	0.5000	14.600000	0.000000	0.0000	0.000000	0.000000
59 A&T	0.0676	0.000000	0.000000	0.040500	0.7840	2.336900	0.000000	0.0000	0.000000	0.000000
60 CORNING	0.0000	0.000000	0.000000	0.000000	0.1835	1.831000	0.000000	0.0000	0.000000	0.000000
61 OBSIDIAN	0.0322	0.000000	0.000000	0.054000	0.8674	5.071400	0.000000	0.0000	0.091600	0.000000
62 CORNING	0.0000	0.000000	0.000000	0.000000	0.1835	1.831000	0.000000	0.0000	0.000000	0.000000
63 RRL2-3134	0.0000	0.000000	0.000000	0.000000	2.5520	2.300000	0.000000	0.0000	0.875200	0.000000
64 OBSIDIAN	0.0322	0.000000	0.000000	0.054000	0.8674	5.071400	0.000000	0.0916	0.000000	0.044700
65 GQU	0.0634	0.000000	0.010600	0.000000	6.6887	0.770900	0.000000	0.0000	0.000000	0.000000
66 GQT	0.0000	0.000000	0.011400	0.000000	1.1276	0.000000	0.000000	0.0000	0.000000	0.000000
67 GQQ	0.0576	0.000000	0.005000	0.000000	1.1309	0.000000	0.000000	0.0000	0.000000	0.000000
68 GQN	0.0000	0.000000	0.000000	0.000000	1.0191	1.000000	0.000000	0.0000	0.006900	0.000000
69 DQH	0.0000	0.000000	0.000000	0.000000	0.0133	1.000000	0.000000	0.0000	0.000000	0.000000
70 DQF	0.0000	0.000000	0.023700	0.010800	0.0150	0.493900	0.000000	0.0000	0.000000	0.000000
71 GRF	0.0000	0.000000	0.009500	0.039800	10.4417	0.072300	0.000000	0.0000	0.000000	0.000000
72 SILICA	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
73 SILICA GLASS	0.7761	0.000000	0.005600	0.002700	0.0075	0.000000	0.000000	0.0000	0.029100	0.000000
74 PYREX 7740	13.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
75 PYREX CMJ	13.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
76 WINDOW	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
77 PB GLASS	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
78 NBS	16.8500	0.000000	0.000000	0.000000	0.0000	7.150000	0.000000	0.0000	0.000000	0.000000
79 LIBYAN DESSERT	0.0644	0.000000	0.000000	0.040500	0.2002	0.012000	0.000000	0.0000	0.000000	0.000000
80 CUA	3.4500	1.190000	0.100000	0.000000	0.0000	0.000000	0.150000	0.0000	0.000000	0.740000
81 FRIT 131	14.7000	0.000000	0.000000	0.500000	1.0000	0.000000	0.000000	0.0000	0.000000	0.500000
82 FRIT21	9.4000	0.000000	0.000000	0.000000	9.7000	0.000000	0.000000	0.0000	0.000000	0.000000
83 FRIT211	11.1000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
84 FRIT153	10.0000	0.000000	0.000000	1.000000	2.0000	0.000000	0.000000	0.0000	0.000000	0.000000
85 FRIT S15	0.0000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
86 FRIT 168A	16.5062	0.000000	0.000600	0.830900	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
87 FRIT S12	20.0000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
88 FRIT S2	20.0000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
89 FRIT165	10.0000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
90 FRIT 160	17.0000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
91 FRIT 165	10.0000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
92 FRIT S17	9.5000	0.000000	0.000000	1.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
93 UMTANUM	0.0393	0.000000	0.034300	0.021800	2.1017	0.433700	0.000000	0.0000	0.000000	0.000000
94 LLNLS29	0.0000	0.000000	0.220000	3.880000	4.4600	0.000000	1.370000	0.0000	0.000000	0.000000
95 BGC-50	0.0000	0.000000	0.000000	0.000000	3.0000	0.000000	0.000000	0.0000	2.000000	0.000000
96 HANFORD BASALT	0.0000	0.000000	0.240000	0.030000	1.6400	0.450000	0.000000	0.0000	0.000000	0.000000
97 SPODUMENE GL CERAM	0.0322	0.056700	0.000000	1.512900	1.4512	0.000000	0.000000	0.0000	0.000000	0.000000
98 SPODUMENE GLASS	0.0322	0.056700	0.000000	1.512900	1.4512	0.000000	0.000000	0.0000	0.000000	0.000000
99 POMONA	0.0377	0.000000	0.030000	0.000000	1.7347	0.457700	0.000000	0.0000	0.000000	0.000000
100 STRIPA GRANITE	0.0584	0.000000	0.005300	0.000000	0.0000	3.987200	0.000000	0.0000	0.000000	0.000000
101 COHASSET	0.0412	0.000000	0.038800	0.027600	2.4686	1.590100	0.000000	0.0000	0.000000	0.000000
102 GRANITE	0.0000	0.000000	0.000000	0.014000	0.0083	5.890500	0.000000	0.0000	0.000000	0.000000
103 MCCOY CANYON	0.0541	0.000000	0.003800	0.021700	2.1851	1.108200	0.000000	0.0000	0.489700	0.000000
104 UMTANUM	0.0393	0.000000	0.035500	0.021800	2.1017	0.433700	0.000000	0.0000	0.453600	0.000000
105 NEPHELINE SYENITE	0.0377	0.000000	0.013400	0.000000	0.0267	0.072300	0.000000	0.0000	0.000000	0.000000
106 P-16F	0.0000	0.000000	0.039000	0.220000	0.1100	1.870000	0.000000	0.0000	0.000000	0.000000
107 P-1	0.0000	1.530000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
108 P-3	3.0000	0.960000	0.000000	0.000000	3.0000	0.000000	0.000000	0.0000	0.000000	0.000000

Ø Glass	22 BaO	23 PbO	24 ThO2	25 28-D NSi (g/m**2)	26 pH	27 St. Ghyl (KC/Mol)	28 Jantzen's St. Ghyl	29 Ghyl (KC/Mol)	30 Jantzen's Ghyl
55 ESF148	0.0000	0.9000	0.000000	62.000000	9.270000	-13.262515	-7.939693	-13.363847	-8.041024
56 ESF149	0.0000	0.0000	0.000000	94.200000	10.200000	-10.773079	-6.863304	-11.341459	-7.431684
57 ESF150	0.0000	0.0000	0.000000	77.220000	10.240000	-12.749528	-7.283268	-13.352733	-7.886472
58 ESF159	0.0000	0.5000	0.000000	97.000000	10.600000	-21.645124	-10.706229	-22.615081	-11.676186
59 A&T	0.0000	0.0000	0.000000	1.900000	6.520000	1.085066	0.907260	1.063675	0.905770
60 CORNING	0.0000	0.0000	0.000000	1.700000	4.700000	1.158271	1.005802	1.158268	1.005799
61 OBSIDIAN	0.0447	0.0000	0.000000	1.210000	6.200000	1.216744	1.060767	1.216030	1.060053
62 CORNING	0.0000	0.0000	0.000000	2.270000	8.280000	1.158271	1.005802	1.147088	0.994619
63 RRL2-3134	0.0000	0.0000	0.000000	4.030000	8.280000	-1.091749	-0.871259	-1.102932	-0.882442
64 OBSIDIAN	0.0000	0.0000	0.000000	1.210000	7.500000	1.122403	0.973323	1.108284	1.059203
65 GQU	0.0000	0.0227	0.000000	5.220000	9.330000	-7.093426	-4.388265	-7.730286	-5.025105
66 GQT	0.0000	0.0000	0.000000	5.920000	9.410000	-7.168516	-4.498418	-7.304344	-4.632246
67 GQQ	0.0000	0.3436	0.000000	2.566500	7.820000	-9.948415	-5.628952	-9.977626	-5.658163
68 GQN	0.0000	0.1390	0.000000	3.633691	8.200000	0.119195	0.095824	0.109879	0.086508
69 DQH	0.0000	0.0000	0.000000	5.118597	8.600000	0.583137	0.479456	0.560002	0.456321
70 DQF	0.0000	0.0754	0.000000	3.394582	8.550000	1.316128	1.144866	1.295467	1.124205
71 GRF	0.0000	0.0000	0.000000	8.902404	9.220000	-6.078637	-3.743728	-6.169735	-3.834826
72 SILICA	0.0000	0.0000	0.000000	0.260000	5.150000	5.590000	5.590000	5.589992	5.589992
73 SILICA GLASS	0.0000	0.0452	0.000000	0.150000	7.600000	5.060146	4.961553	5.042413	4.943819
74 PYREX 7740	0.0000	0.0000	0.000000	0.730000	3.700000	2.265034	2.174742	2.265032	2.174740
75 PYREX CMJ	0.0000	0.0000	0.000000	1.290000	7.100000	2.265034	2.174742	2.265032	2.169090
76 WINDOW	0.0000	0.0000	0.000000	3.640000	7.790000	-5.921104	-4.162166	-5.924748	-4.165808
77 PB GLASS	0.0000	13.2496	0.000000	2.470000	7.010000	-5.463450	-3.751038	-5.464056	-3.751644
78 NBS	0.2700	0.0900	0.000000	3.200000	7.500000	-1.254747	-1.140147	-1.271691	-1.157092
79 LIBYAN DESSERT	0.0000	0.0000	0.000000	0.880000	8.500000	4.874989	4.716810	4.744140	4.585960
80 CUA	0.0000	0.0000	0.000000	1.680000	7.000000	-0.355708	-0.286714	-0.360201	-0.291207
81 FRIT 131	0.0000	0.0000	0.000000	555.000000	11.060000	-10.589072	-7.323718	-14.729693	-11.484338
82 FRIT21	0.0000	0.0000	0.000000	97.800000	10.300000	-8.951509	-6.112249	-11.182429	-8.343168
83 FRIT211	0.0000	0.0000	0.000000	50.230000	10.300000	-12.333998	-8.152275	-14.564918	-10.383195
84 FRIT153	0.0000	0.0000	0.000000	78.960000	9.600000	-5.607993	-4.210321	-6.571280	-5.173608
85 FRIT S15	0.0000	0.0000	0.000000	70.229000	12.200000	-9.492505	-6.196189	-13.062340	-9.766024
86 FRIT 168A	0.0000	0.0000	0.000000	308.412200	10.430000	-7.933625	-6.835387	-10.469312	-8.361074
87 FRIT S12	0.0000	0.0000	0.000000	15.825000	9.500000	-10.359977	-7.126692	-11.191616	-7.958332
88 FRIT S2	0.0000	0.0000	0.000000	38.600000	9.500000	-5.774321	-4.614065	-6.605961	-5.445704
89 FRIT165	0.0000	0.0000	0.000000	62.720000	9.850000	-7.147972	-5.202387	-8.496154	-6.550570
90 FRIT 168	0.0000	0.0000	0.000000	560.381800	11.460000	-7.620922	-5.855396	-12.925406	-10.959880
91 FRIT 165	0.0000	0.0000	0.000000	215.511900	10.460000	-7.147972	-5.202387	-9.743856	-7.798272
92 FRIT S17	0.0000	0.0000	0.000000	154.352900	10.500000	-7.812866	-5.587532	-10.503643	-8.278209
93 UMTANUM	0.0000	0.3892	0.000000	9.260000	7.810000	-7.489548	-4.762039	-7.518106	-4.790598
94 LLNLS29	0.0000	0.0000	0.000000	9.390000	6.500000	-5.532689	-3.771058	-5.532876	-3.771245
95 BGC-50	0.0000	0.0000	0.000000	0.840000	7.180000	-2.541717	-1.984655	-2.542572	-1.985511
96 HANFORD BASALT	0.0000	0.0000	0.000000	6.300000	7.110000	-7.550832	-4.802718	-7.551595	-4.803479
97 SPODUMENE GL CERAM	0.0000	0.0000	0.000000	1.800000	8.300000	2.429399	2.155456	2.344336	2.070393
98 SPODUMENE GLASS	0.0000	0.0000	0.000000	1.850000	8.300000	2.429399	2.155456	2.344336	2.070393
99 POMONA	0.0274	0.0388	0.000000	8.220000	7.690000	-6.924387	-4.386273	-6.946147	-4.408033
100 STRIPA GRANITE	0.0424	0.0992	0.000000	1.290000	7.360000	1.388565	1.241165	1.376311	1.230911
101 COHASSET	0.0000	0.3436	0.000000	6.800000	7.460000	-5.728911	-3.822331	-5.741798	-3.835219
102 GRANITE	0.0000	0.0000	0.000000	0.980000	8.050000	0.893983	0.793698	0.887353	0.787086
103 MCCOY CANYON	0.0000	0.0000	0.000000	5.570000	7.730000	-8.043907	-4.006687	-8.067735	-4.030514
104 UMTANUM	0.0000	0.0000	0.000000	6.030000	7.710000	-6.177122	-4.045074	-6.199892	-4.067844
105 NEPHELINE SYENITE	0.0000	0.0000	0.000000	4.510000	8.360000	-2.738985	-2.207037	-2.835899	-2.303951
106 P-16F	0.0000	0.0000	0.000000	5.790000	8.500000	-5.686478	-3.910881	-5.704924	-3.929329
107 P-1	0.0000	0.0000	0.000000	11.493300	9.970000	-8.077455	-5.518326	-8.470663	-5.911524
108 P-3	0.0000	0.0000	0.000000	11.153300	9.800000	-7.379677	-5.095794	-8.644552	-6.360669

Ø Glass	31 NBO	32 Val. Par.	33
55 ESF148	0.750582	-0.753456	4.141546
56 ESF149	0.679223	-0.762396	4.545420
57 ESF150	0.807307	-0.749602	4.346658
58 ESF159	0.977206	-0.742181	4.674711
59 A&T	0.163970	-0.927233	0.641854
60 CORNING	0.116588	-0.880571	0.530628
61 OBSIDIAN	0.287613	-0.883912	0.190620
62 CORNING	0.116588	-0.880571	0.819780
63 RRL2-3134	0.315315	-0.892400	1.393766
64 OBSIDIAN	0.298594	-0.884158	0.190620
65 GQU	0.822867	-0.984072	1.652497
66 GQT	0.619797	-0.976793	1.778336
67 GQQ	0.748442	-0.989157	0.942543
68 GQN	0.264760	-0.971988	1.290249
69 DQH	0.057189	-0.950076	1.632880
70 DQF	0.071047	-0.884521	1.222181
71 GRF	0.996795	-0.989647	2.186321
72 SILICA	0.000000	-1.000000	-1.347074
73 SILICA GLASS	0.036999	-0.999363	-1.897120
74 PYREX 7740	0.055495	-0.908443	-0.314711
75 PYREX CMJ	0.055495	-0.908443	0.254642
76 WINDOW	0.588298	-0.687584	1.291984
77 PB GLASS	0.484336	-0.485531	0.904218
78 NBS	0.135787	-0.781296	1.163151
79 LIBYAN DESSERT	0.073045	-0.989344	-0.127833
80 CUA	0.228869	-0.943242	0.518794
81 FRIT 131	0.655776	-0.235025	6.318968
82 FRIT21	0.927755	-0.367072	4.582925
83 FRIT211	0.678001	-0.238695	3.916612
84 FRIT153	0.566506	-0.457096	4.368941
85 FRIT S16	0.702997	-0.203282	4.251761
86 FRIT 160A	0.519821	-0.351867	5.731437
87 FRIT S12	0.632871	-0.149440	2.761591
88 FRIT S2	0.411954	-0.501131	3.653252
89 FRIT165	0.553637	-0.353783	4.138680
90 FRIT 168	0.525263	-0.347100	6.328618
91 FRIT 165	0.553637	-0.353783	5.373016
92 FRIT S17	0.578872	-0.319707	5.039242
93 UMTANUM	0.637938	-0.867141	2.225704
94 LLNLS29	0.438882	-0.683840	2.238580
95 BGC-50	0.338299	-0.791867	-0.174353
96 HANFORD BASALT	0.609436	-0.872459	1.840550
97 SPODUMENE GL CERAM	0.006956	-0.815098	0.587787
98 SPODUMENE GLASS	0.006956	-0.815098	0.615186
99 POMONA	0.615771	-0.949281	2.106570
100 STRIPA GRANITE	0.033892	-0.852952	0.254642
101 COHASSET	0.582127	-0.902476	1.016923
102 GRANITE	0.053861	-0.837605	-0.020203
103 MCCOY CANYON	0.578329	-0.911478	1.717395
104 UMTANUM	0.597512	-0.929152	1.796747
105 NEPHELINE SYENITE	-0.055985	-0.698057	1.506297
106 P-16F	0.412387	-0.855596	1.756132
107 P-1	0.454401	-0.583586	2.441764
108 P-3	0.572903	-0.591095	2.411735

Ø Glass	1 Al2O3	2 CaO	3 Fe2O3	4 FeO	5 MgO	6 MnO	7 Na2O	8 Li2O	9 NiO	10 SiO2	11 Cr2O3
109 P-40	5.7000	7.2000	10.8400	2.9300	0.8000	2.8800	10.0000	0.0000	0.900000	55.6000	0.300000
110 AY	1.3415	12.9426	1.2095	0.0000	2.2387	0.9439	13.4935	0.0000	0.003800	66.6178	0.000000
111 AX	1.5040	21.2678	1.2024	0.0000	2.4045	0.9878	2.6286	0.1162	0.000000	64.3929	0.000000
112 JQQ	1.1186	15.3212	1.3325	0.0000	6.0694	0.9426	2.6960	0.0431	0.031800	55.1298	0.021900
113 JQR	1.8895	16.2307	1.1152	0.0000	2.5040	0.9038	1.4289	0.0431	0.000000	55.5000	0.000000
114 AV	1.2822	2.3926	0.1858	0.0000	1.0563	0.0000	0.2858	0.0215	0.000000	74.4476	0.000000
115 19K	0.0000	9.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000000	67.0000	0.000000
116 19M	0.2324	8.5491	0.0000	0.0000	0.0663	1.7560	0.1463	0.0215	0.000000	53.5467	0.000000
117 19L	0.0000	8.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000000	56.0000	0.000000
118 1825 ACT	1.1337	6.8561	0.7006	0.0000	4.8091	0.4132	11.0268	0.0215	0.000000	71.4954	0.000000
119 635ACTUAL	3.2122	11.8932	0.1830	0.0000	0.6633	0.5036	14.2888	0.0215	0.022900	66.5322	0.022700
120 642ACTUAL	2.8531	9.3888	0.4947	0.0000	0.6119	0.3744	11.7276	0.0431	0.027200	73.4208	0.017200
121 1824ACT	1.3038	7.2758	0.5562	0.0000	5.1407	0.2970	9.7865	0.0431	0.024200	69.5273	0.017500
122 EZI	2.6340	10.4156	1.8872	0.0000	1.0033	0.9684	16.9000	0.0000	0.018600	62.0397	0.018400
123 AAX	2.6642	7.8215	0.5605	0.0000	0.9452	0.3460	17.1196	0.0000	0.000000	67.0000	0.000000
124 DGH	2.7587	6.8462	0.3531	0.0000	1.5273	0.0052	11.8759	0.0431	0.012700	74.8755	0.010200
125 JXU	1.2490	1.6650	0.1916	0.0000	0.0531	0.0052	0.2696	0.0000	0.025500	72.4968	0.014600
126 TWB	0.3949	0.4282	1.4154	0.0000	0.0358	0.0000	3.2082	0.0000	0.257100	37.0099	0.239700
127 DA	2.1162	4.2258	0.3288	0.0000	0.5572	0.0000	20.5000	0.0000	0.000000	69.0994	0.000000
128 DC	2.0596	2.0588	0.5882	0.0000	0.4942	0.0000	2.4938	0.0000	0.000000	42.0000	0.000000
129 DD	2.0000	1.0000	0.4000	0.0000	0.3000	0.0000	1.0000	0.0000	0.000000	19.7000	0.000000
130 DB	2.0000	3.0000	0.4000	0.0000	1.0000	0.0000	3.0000	0.0000	0.000000	63.5000	0.000000
131 DE	1.5000	1.0000	0.2000	0.0000	0.5000	0.0000	14.5000	0.0000	0.000000	66.0000	0.000000
132 DGW	3.1177	18.5954	1.7156	0.0000	2.9684	0.6843	1.7928	0.0215	0.012700	59.5000	0.014600
133 SCU	1.3397	10.4460	0.7177	0.0000	1.3747	0.0220	2.2242	0.0215	0.192200	73.2710	0.002100
134 UK	0.1568	10.9278	0.3217	0.0000	0.0497	0.0000	18.0000	0.0448	0.000000	59.8000	0.009200
135 EZA	4.2325	19.5888	0.1473	0.0000	1.7578	0.0000	20.0000	0.0861	0.000000	47.8000	0.000000
136 19AF	0.3552	12.8208	0.1487	0.0000	0.0778	0.0000	2.1433	0.0560	0.000000	67.6019	0.000000
137 EZB	3.0988	12.2150	0.1515	0.0000	7.6282	0.0123	9.8000	0.1292	0.018500	49.4178	0.000000
138 EZC	2.2107	6.4643	0.0000	0.0000	10.1985	0.0000	4.3136	0.0000	0.000000	51.5571	0.000000
139 19AG	0.0504	12.2710	0.1221	0.0000	0.0720	0.0000	2.8038	0.0215	0.000000	64.8208	0.000000
140 19AE	0.2381	11.1938	0.2059	0.0000	0.0531	0.0000	3.4104	0.0431	0.022900	72.2014	0.000000
141 DYS	0.2845	8.4931	0.0000	0.0000	0.0846	0.0000	8.0476	0.0215	0.000000	66.4467	0.000000
142 19AH	0.0000	11.3000	0.0000	0.0000	0.0000	0.0000	3.0000	0.0000	0.000000	67.6000	0.000000
143 GPX	0.2475	10.6199	0.2731	0.0000	0.0580	0.0000	20.0000	0.0646	0.008900	69.9551	0.000000
144 GPX-DUP	0.2475	10.6199	0.2731	0.0000	0.0580	0.0000	20.0000	0.0646	0.008900	69.9551	0.000000
145 X	0.2626	8.7088	0.2273	0.0000	0.0514	0.0000	18.0000	0.0000	0.000000	62.9168	0.000000
146 DTJ	0.2967	0.4701	0.2430	0.0000	0.0000	0.0000	20.0852	0.0000	0.000000	23.3184	0.000000
147 DTK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	21.0000	0.0000	0.000000	32.0000	0.000000
148 EZT	2.3808	8.7730	1.1000	0.0000	2.5040	1.2000	16.9000	0.0431	0.000000	66.2000	0.000000
149 DF	1.5000	1.0000	0.5000	0.0000	0.0000	0.0000	1.0000	0.0000	0.000000	30.5000	0.000000
150 zr1a	3.9000	2.9400	10.3000	0.0000	0.8600	0.0000	10.2000	4.0000	0.550000	52.5000	1.240000
151 zr2a	2.7000	3.1000	6.8000	0.0000	0.8400	0.0000	10.3000	4.3000	0.365000	57.2000	0.800000
152 zr3a	0.0000	3.1000	0.0000	0.0000	0.8600	0.0000	8.6000	4.3000	0.000000	57.1000	0.000000
153 zr4a	1.3000	2.8000	3.6000	0.0000	0.7200	0.0000	8.7000	4.0000	0.180000	52.3000	0.390000
154 zr5a	2.7000	2.6200	6.8000	0.0000	0.7400	0.0000	8.7000	3.6000	0.360000	47.6000	0.810000
155 ZR6A	5.3000	2.6000	13.6000	0.0000	0.8000	0.0000	10.3000	3.5000	0.729000	48.3000	1.600000
156 ZR7A	0.0000	3.1000	0.0000	0.0000	0.8300	0.0000	8.6000	4.3000	0.000000	57.0000	0.000000
157 ZR8A	5.2000	2.7000	13.9000	0.0000	0.7500	0.0000	10.4000	3.6000	0.730000	48.3000	1.720000
158 ZR9A	2.5000	3.1000	6.9000	0.0000	0.8400	0.0000	10.4000	4.3000	0.360000	57.3000	0.790000
159 ZR10A	1.2000	3.2000	3.5000	0.0000	0.7700	0.0000	9.5000	4.3000	0.180000	56.3000	0.390000
160 ZR11A	4.9000	2.5000	10.0000	0.0000	0.6800	0.0000	9.5000	3.4000	0.560000	49.7000	1.100000
161 ZR12A	2.5000	2.9000	7.0000	0.0000	0.7300	0.0000	9.5000	4.0000	0.360000	52.8000	0.790000
162 HWMAS1	4.4000	2.8800	10.7000	0.0000	0.7600	0.0000	16.8000	0.0000	0.570000	48.8000	1.280000

0 Glass	12 B203	13 U02	14 SrO	15 ZrO2	16 TiO2	17 K2O	18 Cs2O	19 Sb2O3	20 P2O5	21 Nd2O3
109 P-40	0.0000	1.300000	0.100000	0.000000	0.0000	0.000000	0.100000	0.0000	0.000000	0.700000
110 AY	0.0000	0.000000	0.057000	0.000000	0.0000	1.927400	0.000000	0.0000	0.000000	0.000000
111 AX	0.0000	0.000000	0.000000	0.000000	0.0000	9.624800	0.000000	0.0000	0.000000	0.000000
112 JQQ	0.0000	0.000000	0.011800	0.000000	0.0133	7.059000	0.000000	0.0000	3.826000	0.000000
113 JQR	0.0000	0.000000	0.050900	0.000000	0.0000	18.500000	0.000000	0.0000	1.024100	0.000000
114 AV	0.0000	0.000000	0.000000	0.000000	0.0000	20.000000	0.000000	0.0000	0.000000	0.000000
115 19K	0.0000	0.000000	0.000000	0.000000	0.0000	14.000000	0.000000	0.0000	0.000000	0.000000
116 19M	0.0000	0.000000	0.010600	0.000000	0.0000	11.000000	0.000000	0.0000	0.000000	0.000000
117 19L	0.0000	0.000000	0.000000	0.000000	0.0000	11.000000	0.000000	0.0000	0.000000	0.000000
118 1825 ACT	0.0644	0.000000	0.000000	0.000000	0.0334	2.189300	0.000000	0.0000	0.091600	0.000000
119 636ACTUAL	0.0000	0.000000	0.118300	0.010800	0.0150	3.963100	0.000000	0.0000	0.042200	0.000000
120 642ACTUAL	0.0332	0.000000	0.060300	0.002200	0.0612	0.770900	0.000000	0.0083	0.148600	0.000000
121 1824ACT	0.1288	0.000000	0.047300	0.012200	0.0584	2.349000	0.000000	0.0000	0.114600	0.000000
122 EZI	0.0000	0.000000	0.010600	0.000000	0.0150	0.963700	0.000000	0.0000	0.000000	0.000000
123 AAX	0.0515	0.000000	0.000000	0.000000	0.0000	1.000000	0.000000	1.5000	0.000000	0.000000
124 DGH	0.0000	0.000000	0.008300	0.000000	0.0000	1.000000	0.000000	0.2753	0.000000	0.000000
125 JXU	0.0000	0.000000	0.007100	0.009500	0.0183	20.000000	0.000000	0.0000	0.151200	0.000000
126 TWB	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
127 DA	0.0000	0.000000	0.000000	0.000000	0.0000	0.500000	0.000000	0.0000	0.000000	0.000000
128 DC	0.0000	0.000000	0.000000	0.000000	0.0000	0.614300	0.000000	0.0000	0.000000	0.000000
129 DD	0.0000	0.000000	0.000000	0.000000	0.0000	0.500000	0.000000	0.0000	0.000000	0.000000
130 DB	0.0000	0.000000	0.000000	0.000000	0.0000	2.000000	0.000000	0.0000	0.000000	0.000000
131 DE	0.0000	0.000000	0.000000	0.000000	0.0000	1.000000	0.000000	0.0000	0.000000	0.000000
132 DGW	0.0000	0.000000	0.011800	0.000000	0.0000	10.000000	0.000000	0.0000	0.000000	0.000000
133 SCU	0.0000	0.000000	0.255400	0.243100	0.2218	10.492100	0.000000	0.0000	0.000000	0.000000
134 UK	0.0000	0.000000	0.008300	0.000000	0.0634	0.000000	0.159000	10.0000	0.000000	0.000000
135 EZA	0.0000	0.000000	0.000000	0.000000	0.0000	6.312100	0.000000	0.1000	0.000000	0.000000
136 19AF	0.0000	0.000000	0.000000	0.000000	0.0000	8.384000	0.000000	0.0000	0.000000	0.000000
137 EZB	0.0000	0.000000	0.000000	0.000000	0.0000	15.200000	0.000000	2.0000	0.000000	0.000000
138 EZC	0.0000	0.000000	0.000000	0.000000	0.0000	23.800000	0.000000	3.2000	0.000000	0.000000
139 19AG	0.0000	0.000000	0.000000	0.000000	0.0000	11.300000	0.000000	0.0000	0.000000	0.000000
140 19AE	0.0000	0.000000	0.000000	0.000000	0.0000	12.000000	0.000000	0.0000	0.000000	0.000000
141 DYS	13.2990	0.000000	0.000000	0.000000	0.0000	1.915300	0.000000	0.0000	0.000000	0.000000
142 19AH	0.0000	0.000000	0.000000	0.000000	0.0000	11.300000	0.000000	0.0000	0.000000	0.000000
143 GPX	0.0000	0.000000	0.008300	0.000000	0.0000	0.036100	0.000000	0.0000	0.000000	0.000000
144 GPX-DUP	0.0000	0.000000	0.008300	0.000000	0.0000	0.036100	0.000000	0.0000	0.000000	0.000000
145 X	9.7247	0.000000	0.007100	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
146 DTJ	50.5556	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
147 DTK	47.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
148 EZT	0.0000	0.000000	0.000000	0.000000	0.0000	2.000000	0.000000	0.0000	0.000000	0.000000
149 DF	0.0000	0.000000	0.000000	0.000000	0.0000	0.500000	0.000000	0.0000	0.000000	0.000000
150 zr1a	9.9000	0.000000	0.080000	0.000000	0.0000	0.000000	0.150000	0.0000	0.010000	0.430000
151 zr2a	10.9000	0.000000	0.050000	0.000000	0.0010	0.000000	0.103000	0.0000	0.010000	0.270000
152 zr3a	10.8000	0.000000	0.000000	15.700000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
153 zr4a	9.8000	0.000000	0.030000	15.700000	0.0000	0.000000	0.050000	0.0000	0.000000	0.130000
154 zr5a	9.1000	0.000000	0.050000	15.700000	0.0000	0.000000	0.100000	0.0000	0.010000	0.270000
155 ZR6A	9.0000	0.000000	0.100000	0.000000	0.0020	0.000000	0.200000	0.0000	0.020000	0.570000
156 ZR7A	10.8000	0.000000	0.000000	15.800000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
157 ZR8A	8.8000	0.000000	0.100000	0.000000	0.0000	0.000000	0.210000	0.0000	0.020000	0.580000
158 ZR9A	10.7000	0.000000	0.050000	0.000000	0.0000	0.000000	0.100000	0.0000	0.010000	0.280000
159 ZR10A	10.7000	0.000000	0.030000	7.900000	0.0000	0.000000	0.050000	0.0000	0.000000	0.150000
160 ZR11A	8.2000	0.000000	0.070000	7.500000	0.0000	0.000000	0.150000	0.0000	0.010000	0.380000
161 ZR12A	9.8000	0.000000	0.060000	7.900000	0.0000	0.000000	0.100000	0.0000	0.010000	0.270000
162 HWMAS1	9.3000	0.000000	0.080000	0.700000	0.0300	0.840000	0.160000	0.0000	0.200000	0.410000

Ø Glass	22 BaO	23 PbO	24 ThO2	25 2B-D NSi (g/mm*2)	26 pH	27 St. Ghyl (KC/Mol)	28 Jantzen's St. Ghyl	29 Ghyl (KC/Mol)	30 Jantzen's Ghyl
109 P-40	0.0000	0.0000	0.000000	9.660000	8.000000	-4.054377	-2.933369	-4.060272	-2.939264
110 AY	0.0000	0.0000	0.000000	22.260000	9.820000	-7.511939	-5.087008	-7.813990	-5.389080
111 AX	0.0000	0.0000	0.000000	17.040000	10.450000	-9.077694	-5.857962	-9.883742	-6.664010
112 JQQ	0.0000	0.1691	0.000000	25.922690	9.800000	-10.773451	-6.822932	-11.064686	-7.114168
113 JQR	0.0000	0.0000	0.000000	20.580000	9.920000	-13.544515	-8.400557	-13.905333	-8.761375
114 AV	0.0000	0.0000	0.000000	21.322720	10.540000	-3.738994	-3.042915	-4.641812	-3.945533
115 19K	0.0000	10.0000	0.000000	4.831187	9.250000	-4.419860	-3.355041	-4.518976	-3.452157
116 19M	0.0000	25.0000	0.000000	5.673427	9.100000	-6.831498	-4.679657	-6.901824	-4.749984
117 19L	0.0000	25.0000	0.000000	2.012936	8.710000	-5.392125	-3.855588	-5.421767	-3.885210
118 1825 ACT	0.0000	0.0323	0.000000	28.906050	9.500000	-4.648834	-3.388329	-5.480473	-4.219968
119 835ACTUAL	0.0000	0.0517	0.000000	11.994070	9.800000	-7.677148	-5.302712	-7.968384	-5.593948
120 642ACTUAL	0.0170	0.0520	0.000000	11.291260	9.910000	-3.255421	-2.486814	-4.707672	-3.939065
121 1824ACT	0.0000	0.0797	0.000000	27.696530	9.600000	-4.711383	-3.414602	-5.874670	-4.377890
122 EZI	0.0000	0.0183	0.000000	14.310940	9.980000	-8.060895	-5.468050	-8.480813	-5.867988
123 AAX	0.0000	0.0000	0.000000	14.017790	9.400000	-6.280893	-4.502192	-6.993571	-5.214871
124 DGH	0.0000	0.0000	0.000000	9.706100	9.830000	-2.638803	-2.057798	-2.850028	-2.269023
125 JXU	0.0000	3.0000	0.000000	41.019170	11.970000	-3.534714	-2.911070	-6.619510	-5.995865
126 TWB	11.7233	45.0000	0.000000	4.710000	8.640000	-6.424391	-4.165439	-6.449711	-4.190760
127 DA	0.0000	0.6786	0.000000	190.100000	11.500000	-6.015942	-4.406762	-8.240704	-6.631524
128 DC	20.0000	30.0000	0.000000	2.360000	8.320000	-7.408384	-4.941709	-7.418636	-4.953960
129 DD	30.0000	45.0000	0.000000	8.890000	8.070000	-26.814792	-11.820201	-26.821712	-11.827121
130 DB	10.0000	15.0000	0.000000	0.880000	8.280000	-1.514597	-1.202212	-1.525780	-1.213396
131 DE	0.0000	15.2000	0.000000	5.870000	10.330000	-3.550135	-2.714793	-4.236247	-3.400906
132 DQW	0.0000	0.1185	0.000000	12.746440	10.040000	-8.805272	-5.738013	-9.247219	-6.179960
133 SCU	0.1865	0.0000	0.000000	12.310000	10.000000	-3.515909	-2.696331	-3.929510	-3.109931
134 UK	0.0000	0.0000	0.000000	31.590000	10.540000	-8.419709	-5.717560	-9.322327	-6.820178
135 EZA	0.0000	0.0000	0.000000	18.530000	10.510000	-21.708421	-11.207363	-22.578244	-12.077188
136 19AF	0.0000	0.0000	0.000000	35.440000	10.200000	-3.981271	-3.045710	-4.549650	-3.614090
137 EZB	0.0000	0.0000	0.000000	25.150000	10.880000	-19.654846	-10.626167	-20.717875	-11.689396
138 EZC	0.0000	0.0000	0.000000	34.030000	11.000000	-18.993644	-10.699368	-20.468333	-12.172057
139 19AG	0.0000	0.0000	0.000000	30.010000	10.050000	-5.919407	-4.378123	-6.368646	-4.827362
140 19AE	0.0000	0.0000	0.000000	28.167090	10.050000	-4.631642	-3.510171	-5.080881	-3.959410
141 DYS	0.0000	0.5171	0.000000	59.113050	9.320000	-3.477114	-2.813064	-4.130613	-3.439563
142 19AH	0.0000	0.0000	0.000000	34.654300	10.070000	-5.678549	-4.178990	-6.042618	-4.643056
143 GPX	0.0000	0.0000	0.000000	105.050200	11.280000	-7.516783	-5.213341	-9.382590	-7.059148
144 GPX-DUP	0.0000	0.0000	0.000000	52.601570	9.920000	-7.516783	-5.213341	-7.877601	-5.574159
145 X	0.0000	0.0000	0.000000	43.524410	9.710000	-6.535680	-4.847420	-7.658738	-5.970278
146 DTJ	0.0000	0.0000	0.000000	246.800000	9.180000	-14.606728	-11.260395	-15.084016	-11.737683
147 DTK	0.0000	0.0000	0.000000	108.310000	9.200000	-12.738386	-9.947509	-13.250160	-10.459283
148 EZT	0.0000	0.0000	0.000000	18.130000	9.550000	-7.987469	-5.437669	-8.187911	-5.618110
149 DF	0.0000	64.0000	0.000000	1.470000	8.500000	-4.551721	-2.808910	-4.570170	-2.827358
150 zr1a	0.0910	0.0000	0.000000	13.000000	9.700000	-5.650064	-4.222398	-6.757777	-5.330109
151 zr2a	0.0520	0.0000	0.000000	15.000000	9.700000	-5.800257	-4.356517	-6.907969	-5.464230
152 zr3a	0.0000	0.0000	0.000000	12.000000	9.700000	-1.502150	-1.042958	-2.150983	-2.150671
153 zr4a	0.0300	0.0000	0.000000	7.000000	9.300000	-1.097484	-0.756747	-1.703684	-1.362927
154 zr5a	0.0500	0.0000	0.000000	8.000000	9.500000	-0.678924	-0.464962	-1.510563	-1.296601
155 ZR6A	0.1100	0.0000	0.000000	13.000000	9.700000	-5.256255	-3.939951	-6.363988	-5.047664
156 ZR7A	0.0000	0.0000	0.000000	12.000000	9.700000	-1.470662	-1.020581	-2.578375	-2.128294
157 ZR8A	0.1300	0.0000	0.000000	13.000000	9.700000	-5.343075	-3.988289	-6.450788	-5.095002
158 ZR9A	0.0600	0.0000	0.000000	15.000000	9.800000	-5.827745	-4.370363	-7.092620	-5.635238
159 ZR10A	0.0400	0.0000	0.000000	12.000000	9.700000	-3.843630	-2.763565	-4.951343	-3.871278
160 ZR11A	0.0600	0.0000	0.000000	7.000000	9.400000	-2.628528	-1.912362	-3.341206	-2.625041
161 ZR12A	0.0600	0.0000	0.000000	9.000000	9.500000	-3.426551	-2.462065	-4.258190	-3.293704
162 HWMAS1	0.1000	0.0000	0.000000	12.790000	9.140000	-6.220909	-4.634080	-6.681636	-5.094808

Ø Glass	31 NBO	32 Val. Par.	33
109 P-40	0.413492	-0.755758	2.267994
110 AY	0.620761	-0.661936	3.102791
111 AX	0.683087	-0.788769	2.835564
112 JQQ	0.709010	-0.814635	3.255119
113 JQR	0.726471	-0.852930	3.024320
114 AV	0.354898	-0.689626	3.059773
115 19K	0.481834	-0.769954	1.575092
116 19M	0.626481	-0.762040	1.735793
117 19L	0.569926	-0.791062	0.699594
118 1825 ACT	0.524577	-0.719896	3.364051
119 635ACTUAL	0.580131	-0.813076	2.484412
120 642ACTUAL	0.436782	-0.728753	2.424029
121 1824ACT	0.532797	-0.738244	3.321307
122 EZI	0.596533	-0.578758	2.661024
123 AAX	0.548535	-0.588705	2.640327
124 DGH	0.408301	-0.723234	2.272755
125 JXU	0.335841	-0.681541	3.714040
126 TWB	0.686772	-0.871927	1.549688
127 DA	0.506474	-0.519355	5.247550
128 DC	0.621488	-0.897808	0.850662
129 DD	1.062661	-0.926447	1.930071
130 DB	0.379953	-0.886792	-0.150823
131 DE	0.448888	-0.821958	1.769855
132 DGW	0.644851	-0.795505	2.545252
133 SCU	0.453757	-0.794201	2.510412
134 UK	0.774702	-0.549074	3.452841
135 EZA	0.918467	-0.373106	2.919391
136 19AF	0.535430	-0.812011	3.587841
137 EZB	0.905197	-0.480015	3.224858
138 EZC	0.887605	-0.485365	3.527242
139 19AG	0.591136	-0.744893	3.583797
140 19AE	0.479707	-0.737286	3.338154
141 DYS	0.378724	-0.761082	4.079465
142 19AH	0.571892	-0.730102	3.545422
143 GPX	0.607968	-0.544680	4.654438
144 GPX-DUP	0.607968	-0.544680	3.982746
145 X	0.511693	-0.590406	3.773322
146 DTJ	0.452083	0.155387	5.508578
147 DTK	0.438184	-0.034678	4.684997
148 EZT	0.602080	-0.681823	2.780681
149 DF	0.723872	-0.938508	0.385282
150 zr1a	0.408745	-0.515011	2.584949
151 zr2a	0.433303	-0.507584	2.708050
152 zr3a	0.771434	-0.550371	2.484907
153 zr4a	0.753636	-0.552968	1.945910
154 zr5a	0.735809	-0.564114	2.079442
155 ZR6A	0.361785	-0.530144	2.584949
156 ZR7A	0.773314	-0.549933	2.484907
157 ZR8A	0.370585	-0.524034	2.584949
158 ZR9A	0.437122	-0.505195	2.708050
159 ZR10A	0.612337	-0.522064	2.484907
160 ZR11A	0.511124	-0.566831	1.945910
161 ZR12A	0.581079	-0.533565	2.197225
162 HWMAS1	0.405742	-0.525051	2.540664

0 Glass	1 Al2O3	2 CaO	3 Fe2O3	4 FeO	5 MgO	6 MnO	7 Na2O	8 Li2O	9 NiO	10 SiO2	11 Cr2O3
183 HWMAS2	5.0000	3.1300	11.9000	0.0000	0.8700	0.0000	0.1500	9.5000	0.630000	54.4000	1.280000
184 HWMAS3	3.9000	2.5100	9.9700	0.0000	0.6800	0.0000	0.1500	0.0000	0.520000	44.9000	1.100000
186 HWMAS4	4.1000	2.8200	10.5000	0.0000	0.7400	0.0000	5.8000	2.7000	0.570000	48.9000	1.200000
186 HWMAS5	4.1000	2.8500	10.8000	0.0000	0.7500	0.0000	8.4000	0.0000	0.550000	47.0000	1.200000
187 HWMAS6	4.2000	2.8200	10.7000	0.0000	0.7900	0.0000	0.1500	4.4000	0.570000	49.0000	1.260000
188 HWYS1	0.0000	3.0000	4.8500	0.0000	1.1000	0.0000	7.4000	3.7000	2.160000	51.6000	4.930000
189 HWYS2	3.1000	2.7800	8.6000	0.0000	0.8900	0.0000	11.2000	3.7000	0.780000	51.7000	1.730000
170 HWYS3	0.0000	2.9500	5.0000	0.0000	1.1000	0.0000	7.3000	3.7000	1.940000	50.5000	4.400000
171 HWYS4	0.0000	2.7800	14.9000	0.0000	0.8200	0.0000	7.4000	3.8000	0.320000	58.0000	0.710000
172 HWYS5	3.1000	2.8000	8.7000	0.0000	0.8400	0.0000	11.1000	3.6000	0.780000	52.0000	1.800000
173 HWYS6	8.5000	2.8000	14.5000	0.0000	0.7100	0.0000	7.4000	3.6000	0.220000	50.3000	0.450000
174 HWYS7	8.0000	2.9000	4.8000	0.0000	0.8500	0.0000	7.3000	3.6000	0.750000	55.4000	1.640000
175 hwys8	8.3000	2.8000	5.1000	0.0000	0.7800	0.0000	16.7000	3.5000	0.000000	49.7000	0.000000
176 HWYS10	3.2000	2.8000	8.5000	0.0000	0.9500	0.0000	11.4000	3.8000	0.780000	52.2000	1.700000
177 HWYS11	5.4000	2.7100	5.1000	0.0000	0.7800	0.0000	17.6000	3.7000	0.000000	55.0000	0.040000
178 HWYS12	8.6000	2.9000	15.3000	0.0000	1.2000	0.0000	7.3000	3.4000	0.000000	51.2000	0.000000
179 HWYS13	0.0000	2.7000	15.1000	0.0000	0.7000	0.0000	17.3000	3.6000	0.000000	50.3000	0.000000
180 HWYS14	0.0000	3.0000	13.2000	0.0000	0.9300	0.0000	7.6000	3.7000	1.290000	51.4000	2.900000
181 HWYS15	0.0000	2.9600	11.2000	0.0000	0.9000	0.0000	7.6000	3.6000	1.290000	51.3000	3.000000
182 HWCRC	4.5000	2.8600	11.3000	0.0000	0.9100	0.0000	10.3000	3.8600	0.600000	52.5000	0.000000
183 HWCRC1	4.5300	2.8600	11.3000	0.0000	0.8900	0.0000	10.1000	3.7800	0.590000	52.2000	0.980000
184 HWCRC134	4.5200	2.8600	11.2000	0.0000	0.8900	0.0000	10.2000	3.8400	0.590000	51.9000	1.330000
185 HWCRC2	4.4700	2.8400	11.1000	0.0000	0.9000	0.0000	10.2000	3.8100	0.590000	51.7000	2.000000
186 HWCRC5	4.4700	2.8200	11.2000	0.0000	0.9000	0.0000	10.2000	3.8700	0.590000	52.0000	0.000000
187 U308_1	4.3300	2.8700	10.9000	0.0000	0.8100	0.0000	10.7000	3.7300	0.580000	51.9000	1.210000
188 U308_2	4.2200	2.8300	10.8000	0.0000	0.8400	0.0000	10.5000	3.6600	0.570000	51.2000	1.160000
189 U308_3	4.0200	2.8500	9.9100	0.0000	0.9400	0.0000	10.3000	3.6200	0.530000	51.7000	1.140000
190 U308_4	3.7700	2.7900	8.9000	0.0000	1.0300	0.0000	10.3000	3.8000	0.490000	51.3000	1.020000
191 U308_5	3.1700	2.7900	8.0700	0.0000	0.7600	0.0000	9.6500	3.6200	0.450000	50.5000	0.920000
192 U308_6	2.8700	2.8300	7.2300	0.0000	0.7900	0.0000	9.7400	3.6100	0.400000	50.0000	0.850000
193 1-9	1.0200	0.3900	20.4300	0.0000	0.0000	0.0000	16.3600	0.0000	0.000000	61.7900	0.000000
194 2-38	3.2900	4.6200	5.9600	0.0000	0.0000	0.0000	17.3600	0.0000	0.217000	42.1200	0.458800
195 3-15	1.3400	0.3100	20.8600	0.0000	0.0000	0.0000	12.3900	0.0000	0.739200	43.9800	1.562800
196 4-44	8.7500	5.9000	7.4300	0.0000	0.0000	0.0000	18.7200	0.0000	0.259350	44.1600	0.548340
197 5-40	3.4600	5.0800	6.2000	0.0000	0.0000	0.0000	28.7300	0.0000	0.280350	42.2000	0.592740
198 6-71	12.3000	15.1600	6.9700	0.0000	0.0000	0.0000	30.0200	0.0000	0.000000	36.5500	0.000000
199 7-34	4.5100	6.2500	8.1000	0.0000	0.0000	0.0000	19.1700	0.0000	0.288050	45.3200	0.609020
200 8-62	5.6400	1.2300	11.6300	0.0000	0.0000	0.0000	16.3900	0.0000	0.000000	54.1000	0.000000
201 9-3	8.1400	0.0000	17.1900	0.0000	0.0000	0.0000	12.0000	0.0000	0.000000	62.6700	0.000000
202 10-30	0.6900	15.2700	17.0100	0.0000	0.0000	0.0000	30.0300	0.0000	0.000000	37.0000	0.000000
203 11-57	4.4000	0.2100	0.0000	0.0000	0.0000	0.0000	29.7700	0.0000	0.718550	35.9800	1.519220
204 12-65	0.7900	0.0000	10.9000	0.0000	0.0000	0.0000	15.6100	0.0000	0.000000	60.8300	0.000000
206 13-60	0.9200	2.2500	13.4800	0.0000	0.0000	0.0000	16.1300	0.0000	0.373450	47.5700	0.789580
206 14-67	0.9800	0.4000	20.6300	0.0000	0.0000	0.0000	6.8900	0.0000	0.000000	62.5000	0.000000
207 15-74	12.2100	0.0000	19.7400	0.0000	0.0000	0.0000	9.2600	0.0000	0.000000	37.8400	0.000000
208 16-58	1.0100	15.1500	21.2100	0.0000	0.0000	0.0000	18.1800	0.0000	0.000000	37.2700	0.000000
209 17-21	0.8100	0.2200	20.5000	0.0000	0.0000	0.0000	29.7900	0.0000	0.000000	37.4200	0.000000
210 18-59	12.8300	0.3000	0.0000	0.0000	0.0000	0.0000	29.2100	0.0000	0.737450	36.5800	1.559180
211 19-73	12.4400	9.4300	0.0000	0.0000	0.0000	0.0000	7.5200	0.0000	0.725550	35.3300	1.534020
212 20-22	1.0400	0.3900	20.8500	0.0000	0.0000	0.0000	29.5600	0.0000	0.376250	37.4000	0.795520
213 21-36	2.9200	4.2300	5.2400	0.0000	0.0000	0.0000	16.3300	0.0000	0.207200	60.2000	0.438080
214 22-27	8.2700	7.4800	0.0000	0.0000	0.0000	0.0000	28.9100	0.0000	0.000000	35.5500	0.000000
215 23-61	0.9100	1.3100	13.4400	0.0000	0.0000	0.0000	13.4400	0.0000	0.384650	53.5500	0.813260
216 24-41	4.9800	0.6000	9.0600	0.0000	0.0000	0.0000	20.1000	0.0000	0.344050	46.2800	0.727420

0 Glass	12 B203	13 U02	14 SrO	15 ZrO2	16 TiO2	17 K2O	18 Cs2O	19 Sb2O3	20 P2O5	21 Nd2O3
163 HWMAS2	10.4000	0.000000	0.000000	0.650000	0.0300	1.680000	0.180000	0.0000	0.200000	0.470000
164 HWMAS3	8.4000	0.000000	0.000000	0.500000	0.0300	23.300000	0.150000	0.0000	0.200000	0.400000
165 HWMAS4	9.0000	0.000000	0.000000	0.650000	0.0300	9.570000	0.180000	0.0000	0.200000	0.420000
166 HWMAS5	9.1000	0.000000	0.000000	0.580000	0.0300	13.200000	0.160000	0.0000	0.200000	0.410000
167 HWMAS6	9.4000	0.000000	0.000000	0.580000	0.0300	14.000000	0.160000	0.0000	0.200000	0.440000
168 HWYS1	9.7000	0.000000	0.310000	2.000000	0.0100	0.000000	0.670000	0.0000	0.060000	1.150000
169 HWYS2	9.8000	0.000000	0.110000	0.760000	0.0000	0.000000	0.250000	0.0000	0.020000	0.650000
170 HWYS3	9.7000	0.000000	0.280000	1.900000	0.0100	0.000000	0.570000	0.0000	0.050000	1.600000
171 HWYS4	9.7000	0.000000	0.000000	0.300000	0.0000	0.000000	0.050000	0.0000	0.010000	0.760000
172 HWYS5	9.7000	0.000000	0.120000	0.760000	0.0000	0.000000	0.200000	0.0000	0.020000	0.570000
173 HWYS6	9.8000	0.000000	0.040000	0.210000	0.0000	0.000000	0.060000	0.0000	0.010000	0.100000
174 HWYS7	9.4000	0.000000	0.120000	0.720000	0.0000	0.000000	0.230000	0.0000	0.020000	0.300000
175 hwys8	9.4000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.650000
176 HWYS10	9.5000	0.000000	0.120000	0.730000	0.0000	0.000000	0.230000	0.0000	0.020000	0.630000
177 HWYS11	9.5000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
178 HWYS12	9.8000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.750000
179 HWYS13	9.5000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
180 HWYS14	9.7000	0.000000	0.190000	1.230000	0.0000	0.000000	0.370000	0.0000	0.030000	0.650000
181 HWYS15	9.8000	0.000000	0.180000	1.240000	0.0000	0.000000	0.390000	0.0000	0.030000	1.300000
182 HWCRO	9.7800	0.000000	0.080000	0.600000	0.0000	0.000000	0.170000	0.0000	0.020000	0.490000
183 HWCRI	9.7400	0.000000	0.080000	0.600000	0.0000	0.000000	0.110000	0.0000	0.020000	0.480000
184 HWCRI34	9.6900	0.000000	0.080000	0.590000	0.0000	0.000000	0.170000	0.0000	0.020000	0.490000
185 HWCRI2	9.5500	0.000000	0.080000	0.670000	0.0000	0.000000	0.170000	0.0000	0.020000	0.490000
186 HWCRI5	9.6300	0.000000	0.080000	0.570000	0.0000	0.000000	0.170000	0.0000	0.020000	0.480000
187 U3O8_1	9.6500	0.000000	0.080000	0.560000	0.0200	0.000000	0.170000	0.0000	0.020000	0.430000
188 U3O8_2	9.5400	0.190000	0.080000	0.610000	0.0200	0.000000	0.170000	0.0000	0.020000	0.440000
189 U3O8_3	9.5000	2.170000	0.070000	0.600000	0.0300	0.000000	0.150000	0.0000	0.010000	0.410000
190 U3O8_4	9.5000	4.640000	0.070000	0.490000	0.0300	0.000000	0.140000	0.0000	0.010000	0.380000
191 U3O8_5	9.3300	6.200000	0.060000	0.450000	0.0300	0.000000	0.130000	0.0000	0.010000	0.330000
192 U3O8_6	9.3000	8.290000	0.060000	0.420000	0.0300	0.000000	0.110000	0.0000	0.010000	0.310000
193 1-9	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
194 2-38	20.4400	0.713000	0.093000	0.124000	0.0000	0.024800	0.093000	0.0000	1.686400	0.111600
195 3-16	0.0000	2.428800	0.316800	0.422400	0.0000	0.084480	0.316800	0.0000	5.744840	0.380160
196 4-44	7.6300	0.652150	0.111150	0.148200	0.0000	0.029640	0.111150	0.0000	2.015520	0.133380
197 5-40	6.3100	0.921150	0.120150	0.180200	0.0000	0.032040	0.120150	0.0000	2.178720	0.144180
198 6-71	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
199 7-34	8.4100	0.948450	0.123450	0.164600	0.0000	0.032920	0.123450	0.0000	2.238560	0.148140
200 8-62	11.0100	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
201 9-3	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
202 10-30	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
203 11-57	9.1100	2.360950	0.307950	0.410600	0.0000	0.082120	0.307950	0.0000	5.684160	0.369540
204 12-65	11.8600	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
205 13-60	8.9800	1.227050	0.160050	0.213400	0.0000	0.042680	0.160050	0.0000	2.902240	0.192060
206 14-67	8.5900	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
207 15-74	20.9600	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
208 16-58	7.1700	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
209 17-21	11.2600	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
210 18-69	0.0000	2.423050	0.310050	0.421400	0.0000	0.084280	0.310050	0.0000	5.731040	0.379280
211 19-73	14.5500	2.383950	0.310950	0.414600	0.0000	0.082920	0.310950	0.0000	5.638560	0.373140
212 20-22	0.0000	1.236250	0.161250	0.215000	0.0000	0.043000	0.161250	0.0000	2.924000	0.193500
213 21-36	5.1400	0.680800	0.080800	0.118400	0.0000	0.023680	0.080800	0.0000	1.610240	0.106560
214 22-27	19.8200	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
215 23-61	6.3700	1.263850	0.164850	0.219800	0.0000	0.043960	0.164850	0.0000	2.969280	0.197820
216 24-41	9.1600	1.130450	0.147450	0.196800	0.0000	0.039320	0.147450	0.0000	2.673760	0.176940

Ø Glass	22 BaO	23 PbO	24 ThO2	25 20-D NSI (g/m**2)	26 pH	27 St. Ghyd (KC/Mol)	28 Jantzen's St. Ghyd	29 Ghyd (KC/Mol)	30 Jantzen's Ghyd
163 HWMAS2	0.1100	0.0000	0.000000	11.470000	0.970000	-5.403376	-4.024002	-5.820851	-4.361477
164 HWMAS3	0.0900	0.0000	0.000000	25.180000	9.370000	-9.101655	-8.836822	-9.781090	-7.516056
165 HWMAS4	0.1000	0.0000	0.000000	11.960000	9.000000	-6.984122	-5.178407	-7.321157	-5.535522
166 HWMAS6	0.0900	0.0000	0.000000	11.970000	9.130000	-8.101822	-6.010030	-8.554438	-6.462652
167 HWMAS8	0.1100	0.0000	0.000000	12.050000	9.060000	-7.683156	-5.659721	-8.082069	-6.050635
168 HWVS1	0.3600	0.0000	0.000000	40.150000	9.860000	-4.282935	-3.163372	-5.648154	-4.528591
169 HWVS2	0.1300	0.0000	0.000000	13.900000	9.480000	-8.000304	-4.417950	-6.815201	-5.224788
170 HWVS3	0.3300	0.0000	0.000000	42.410000	10.150000	-4.474459	-3.305226	-6.385951	-5.216718
171 HWVS4	0.0500	0.0000	0.000000	33.880000	9.820000	-3.255279	-2.550575	-4.553102	-3.848398
172 HWVS5	0.1300	0.0000	0.000000	13.520000	9.590000	-5.758717	-4.256607	-6.708266	-5.205235
173 HWVS8	0.0400	0.0000	0.000000	10.040000	8.980000	-3.401884	-2.676864	-3.733038	-3.008018
174 HWVS7	0.1300	0.0000	0.000000	6.150000	8.990000	-3.557227	-2.770885	-3.907642	-3.129300
175 hwvs8	0.0800	0.0000	0.000000	11.970000	9.730000	-9.354244	-6.573151	-10.507774	-7.726630
176 HWVS10	0.1300	0.0000	0.000000	13.210000	9.530000	-6.144164	-4.497045	-7.013949	-5.367439
177 HWVS11	0.0800	0.0000	0.000000	14.560000	10.220000	-9.030165	-6.373010	-11.095806	-8.430661
178 HWVS12	0.0800	0.0000	0.000000	9.750000	9.530000	-3.347748	-2.643674	-4.217542	-3.513368
179 HWVS13	0.0800	0.0000	0.000000	62.550000	10.950000	-8.998662	-6.267489	-12.068864	-10.106864
180 HWVS14	0.2200	0.0000	0.000000	34.530000	10.130000	-3.785178	-2.845961	-5.635882	-4.716666
181 HWVS15	0.2200	0.0000	0.000000	33.880000	10.050000	-3.911160	-2.959317	-5.623180	-4.671337
182 HWCRC0	0.0890	0.0000	0.000000	12.080000	9.680000	-5.568254	-4.157170	-6.848060	-5.234976
183 HWCRC1	0.0850	0.0000	0.000000	12.180000	9.690000	-5.181205	-3.888585	-6.273900	-4.979261
184 HWCRC134	0.0850	0.0000	0.000000	12.180000	9.650000	-5.264221	-3.935436	-6.298124	-4.989338
185 HWCRC2	0.0840	0.0000	0.000000	11.440000	9.710000	-5.085397	-3.801191	-6.208255	-4.924048
186 HWCRC5	0.0840	0.0000	0.000000	12.420000	9.730000	-5.602147	-4.179049	-6.755678	-5.332579
187 U308_1	0.0900	0.0000	0.000000	11.100000	9.800000	-5.462503	-4.072097	-6.425790	-5.036284
188 U308_2	0.1000	0.0000	0.000000	11.900000	9.800000	-5.454590	-4.060597	-6.417077	-5.029884
189 U308_3	0.0800	0.0000	0.000000	12.300000	9.400000	-5.372501	-4.020412	-6.085180	-4.733091
190 U308_4	0.0800	0.0000	0.000000	13.000000	9.400000	-5.638110	-4.215079	-6.350788	-4.927757
191 U308_5	0.0600	0.0000	0.000000	12.700000	9.500000	-5.501852	-4.142443	-6.333491	-4.974082
192 U308_6	0.0600	0.0000	0.000000	13.900000	9.400000	-5.796652	-4.349846	-6.509330	-5.062525
193 1-9	0.0000	0.0000	0.000000	14.800000	9.500000	-1.280791	-1.023135	-1.424015	-1.186359
194 2-38	0.0000	0.0000	2.201000	70.900000	9.500000	-9.530993	-7.126612	-10.362632	-7.950251
195 3-15	0.0000	0.0000	7.497800	12.800000	9.200000	-3.157821	-2.563270	-3.245100	-2.650549
196 4-44	0.0000	0.0000	2.630550	9.500000	9.400000	-9.369926	-6.643797	-10.082805	-7.356476
197 5-40	0.0000	0.0000	2.843550	237.400000	12.300000	-16.696495	-10.282772	-24.945087	-18.532164
198 6-71	0.0000	0.0000	0.000000	24.500000	12.200000	-24.051295	-12.035656	-27.621130	-15.605491
199 7-34	0.0000	0.0000	2.921650	13.200000	9.800000	-9.934825	-6.967558	-11.199700	-8.232433
200 8-62	0.0000	0.0000	0.000000	13.900000	9.200000	-4.057084	-3.260345	-4.568858	-3.780120
201 9-3	0.0000	0.0000	0.000000	5.000000	8.800000	0.878026	0.758855	0.841759	0.722368
202 10-30	0.0000	0.0000	0.000000	345.700000	13.000000	-23.956678	-11.754794	-29.478635	-17.274752
203 11-57	0.0000	0.0000	7.288150	516.500000	12.300000	-19.278333	-12.171107	-27.527725	-20.420579
204 12-65	0.0000	0.0000	0.000000	28.200000	9.300000	-2.872645	-2.393700	-3.478825	-2.999880
205 13-60	0.0000	0.0000	3.787850	32.700000	9.500000	-8.097325	-4.718018	-8.928964	-5.549657
206 14-67	0.0000	0.0000	0.000000	16.600000	8.600000	2.028204	1.859389	1.866813	1.697918
207 15-74	0.0000	0.0000	0.000000	8.700000	8.400000	-1.983757	-1.759835	-2.089416	-1.865495
208 16-58	0.0000	0.0000	0.000000	11.400000	10.600000	-13.189832	-7.990489	-18.122990	-10.923846
209 17-21	0.0000	0.0000	0.000000	159.200000	11.700000	-13.827128	-9.059677	-19.891673	-15.124222
210 18-69	0.0000	0.0000	7.479850	29.400000	11.300000	-17.901658	-11.181999	-19.808189	-13.008530
211 19-73	0.0000	0.0000	7.359150	8.900000	8.400000	-8.351599	-6.397141	-8.457258	-6.502801
212 20-22	0.0000	0.0000	3.816250	161.700000	12.300000	-15.022959	-9.331222	-18.018462	-13.124725
213 21-38	0.0000	0.0000	2.101800	10.900000	9.500000	-5.039872	-3.888520	-5.071311	-4.720160
214 22-27	0.0000	0.0000	0.000000	58.000000	11.800000	-19.017567	-11.695142	-25.415739	-18.093315
215 23-61	0.0000	0.0000	3.901450	19.300000	9.400000	-3.306162	-2.704280	-4.018041	-3.418958
216 24-41	0.0000	0.0000	3.489850	17.700000	9.600000	-7.998099	-6.024773	-8.961386	-6.980806

Ø Glass	31 NBO	32 Val. Par.	33
163 HWMAS2	0.423652	-0.489578	2.439735
164 HWMAS3	0.389368	-0.536077	3.228050
165 HWMAS4	0.411082	-0.613343	2.481588
166 HWMAS5	0.408456	-0.616868	2.482404
167 HWMAS6	0.424913	-0.497589	2.489065
168 HWVS1	0.652738	-0.575013	3.692622
169 HWVS2	0.478348	-0.494335	2.631889
170 HWVS3	0.643423	-0.589383	3.747384
171 HWVS4	0.339231	-0.603797	3.522825
172 HWVS5	0.470964	-0.504197	2.604170
173 HWVS6	0.204653	-0.619125	2.308577
174 HWVS7	0.347863	-0.623626	2.098018
175 hwvs8	0.454339	-0.370376	2.482404
176 HWVS10	0.483509	-0.488836	2.580974
177 HWVS11	0.485431	-0.363228	2.878278
178 HWVS12	0.187581	-0.638787	2.277267
179 HWVS13	0.483370	-0.340318	4.413404
180 HWVS14	0.475003	-0.584938	3.541829
181 HWVS15	0.501650	-0.583838	3.522825
182 HWCRC0	0.367307	-0.523754	2.489894
183 HWCRC1	0.384829	-0.534230	2.499795
184 HWCRC134	0.400024	-0.527786	2.499795
185 HWCRC2	0.419974	-0.530042	2.437116
186 HWCRC5	0.368005	-0.521503	2.519308
187 U308_1	0.405191	-0.518482	2.406946
188 U308_2	0.409128	-0.520418	2.478538
189 U308_3	0.431379	-0.529750	2.509599
190 U308_4	0.484194	-0.525896	2.564949
191 U308_5	0.480025	-0.528802	2.541802
192 U308_6	0.515480	-0.521748	2.631889
193 1-0	0.185046	-0.614885	2.694627
194 2-38	0.454374	-0.457892	4.261270
195 3-15	0.323875	-0.688141	2.549445
196 4-44	0.451234	-0.493547	2.251292
197 5-40	0.727044	-0.193719	5.469746
198 6-71	0.781867	-0.202988	3.198673
199 7-34	0.525965	-0.470843	2.580217
200 8-62	0.214838	-0.572026	2.631889
201 9-3	0.008615	-0.727506	1.609438
202 10-30	0.866182	-0.187586	5.845571
203 11-57	0.834498	-0.096450	6.247075
204 12-85	0.232825	-0.597777	3.339322
205 13-80	0.398922	-0.551939	3.487375
206 14-87	-0.028857	-0.029961	2.809403
207 15-74	-0.141978	-0.720614	2.183323
208 16-58	0.588682	-0.474382	2.433613
209 17-21	0.495591	-0.101213	5.070161
210 18-69	0.730033	-0.212531	3.380995
211 19-73	0.450341	-0.771489	1.931521
212 20-22	0.629427	-0.176171	5.085743
213 21-36	0.417095	-0.596958	2.388763
214 22-27	0.665877	-0.079136	4.025352
215 23-61	0.313705	-0.647888	2.980106
216 24-41	0.416987	-0.445780	2.873565

0 Glass	1 Al2O3	2 CaO	3 Fe2O3	4 FeO	5 MgO	6 MnO	7 Na2O	8 Li2O	9 NiO	10 SiO2	11 Cr2O3
217 25-64	12.4900	0.4200	0.0000	0.0000	0.0000	0.0000	15.6300	0.0000	0.000000	59.8800	0.000000
218 26-10	0.6400	0.2000	0.0000	0.0000	0.0000	0.0000	11.8600	0.0000	0.000000	61.2000	0.000000
219 27-2	8.3800	0.2100	0.0000	0.0000	0.0000	0.0000	29.9600	0.0000	0.000000	61.4500	0.000000
220 28-45	5.0400	7.9300	0.0000	0.0000	0.0000	0.0000	20.8200	0.0000	0.323050	47.2100	0.683020
221 29-37	5.2400	7.6800	9.5600	0.0000	0.0000	0.0000	20.9500	0.0000	0.322700	47.3500	0.682280
222 30-14	8.0000	15.4800	0.0000	0.0000	0.0000	0.0000	12.7200	0.0000	0.746200	41.6700	1.577680
223 31-1	8.1500	14.9600	0.0000	0.0000	0.0000	0.0000	16.6500	0.0000	0.000000	60.2500	0.000000
224 32-70	12.5500	0.2100	0.0000	0.0000	0.0000	0.0000	11.2300	0.0000	0.714000	35.7700	1.509600
225 33-6	8.3200	0.1400	0.0000	0.0000	0.0000	0.0000	11.8900	0.0000	0.000000	60.4300	0.000000
226 34-18	8.4700	0.2000	0.0000	0.0000	0.0000	0.0000	12.1500	0.0000	0.711900	38.9200	1.505160
227 35-35	5.5100	8.0600	5.8000	0.0000	0.0000	0.0000	21.9300	0.0000	0.326550	38.9400	0.690420
228 36-19	8.9800	0.2600	20.3100	0.0000	0.0000	0.0000	29.8400	0.0000	0.000000	40.6200	0.000000
229 37-31	0.4000	15.3100	0.0000	0.0000	0.0000	0.0000	28.1300	0.0000	0.746650	34.7800	1.582860
230 38-53	0.6400	0.1700	4.2700	0.0000	0.0000	0.0000	29.4400	0.0000	0.178500	60.3800	0.377400
231 39-59	12.4000	13.7000	4.3000	0.0000	0.0000	0.0000	7.0000	0.0000	0.196350	56.9900	0.415140
232 40-47	5.0700	7.7500	9.7400	0.0000	0.0000	0.0000	20.7800	0.0000	0.000000	47.1200	0.000000
233 41-63	12.5400	1.2000	6.0200	0.0000	0.0000	0.0000	16.2500	0.0000	0.000000	54.2600	0.000000
234 42-34	4.4600	6.3300	8.0000	0.0000	0.0000	0.0000	19.7300	0.0000	0.269150	45.6900	0.569060
235 43-11	6.4200	0.3100	0.0000	0.0000	0.0000	0.0000	12.0400	0.0000	0.735000	60.2200	1.554000
236 44-23	0.9000	0.1600	11.5100	0.0000	0.0000	0.0000	30.1300	0.0000	0.733600	38.3400	1.551040
237 45-17	8.2500	0.0700	0.0000	0.0000	0.0000	0.0000	29.8400	0.0000	0.742000	40.6300	1.568800
238 46-58	9.1300	8.1000	20.2000	0.0000	0.0000	0.0000	12.3100	0.0000	0.466550	36.9200	0.986420
239 47-4	0.4100	0.1500	0.0000	0.0000	0.0000	0.0000	13.2800	0.0000	0.686000	60.5500	1.450400
240 48-32	8.1800	0.4000	17.4900	0.0000	0.0000	0.0000	10.9700	0.0000	0.685650	43.3600	1.449660
241 49-13	0.2900	15.1100	0.0000	0.0000	0.0000	0.0000	12.8000	0.0000	0.000000	51.7400	0.000000
242 50-5	1.0400	0.1300	0.0000	0.0000	0.0000	0.0000	18.1600	0.0000	0.704900	60.5300	1.490360
243 51-66	5.6300	0.5300	4.7300	0.0000	0.0000	0.0000	14.5400	0.0000	0.128800	60.5700	0.272320
244 52-42	3.6500	15.1100	6.4600	0.0000	0.0000	0.0000	18.1400	0.0000	0.213150	43.9900	0.450660
245 53-52	0.6400	14.8900	5.5700	0.0000	0.0000	0.0000	12.0500	0.0000	0.227150	60.3600	0.480260
246 54-72	12.0800	15.1100	0.0000	0.0000	0.0000	0.0000	18.3300	0.0000	0.000000	34.7400	0.000000
247 55-27	8.1700	7.0700	0.0000	0.0000	0.0000	0.0000	30.3800	0.0000	0.000000	34.7600	0.000000
248 56-68	0.8300	10.9400	0.0000	0.0000	0.0000	0.0000	7.3300	0.0000	0.768600	58.9400	1.825040
249 57-7	1.1100	4.2300	20.0200	0.0000	0.0000	0.0000	12.2700	0.0000	0.000000	62.3700	0.000000
250 58-39	5.2400	7.0900	9.1900	0.0000	0.0000	0.0000	12.3700	0.0000	0.313950	47.8500	0.663780
251 59-6	8.3200	0.1600	0.0000	0.0000	0.0000	0.0000	11.9300	0.0000	0.000000	60.1400	0.000000
252 60-20	8.4800	0.2400	19.4300	0.0000	0.0000	0.0000	11.7200	0.0000	0.000000	36.5700	0.000000
253 61-60	1.0100	2.4600	12.8100	0.0000	0.0000	0.0000	16.2900	0.0000	0.397950	47.1400	0.841360
254 62-54	4.3800	15.4500	0.0000	0.0000	0.0000	0.0000	12.3200	0.0000	0.431200	35.4900	0.911680
255 63-34	4.4200	6.2700	7.9200	0.0000	0.0000	0.0000	19.8400	0.0000	0.290150	45.2400	0.613460
256 64-28	0.6500	9.1800	20.1700	0.0000	0.0000	0.0000	12.5100	0.0000	0.000000	37.3200	0.000000
257 65-49	0.9500	15.4500	17.1300	0.0000	0.0000	0.0000	12.5100	0.0000	0.564200	37.8400	1.192880
258 67-75	12.0200	0.1900	19.6800	0.0000	0.0000	0.0000	30.4800	0.0000	0.000000	36.8400	0.000000
259 68-50	0.9800	0.4000	20.6300	0.0000	0.0000	0.0000	6.8900	0.0000	0.000000	62.5000	0.000000
260 69-16	8.0600	15.6800	20.3700	0.0000	0.0000	0.0000	12.7300	0.0000	0.000000	42.2600	0.000000
261 70-55	4.5200	0.2500	9.3300	0.0000	0.0000	0.0000	31.0100	0.0000	0.000000	35.1200	0.000000
262 72-2	8.3600	0.3300	0.0000	0.0000	0.0000	0.0000	30.8400	0.0000	0.000000	60.4700	0.000000
263 73-1	8.3000	15.3000	0.0000	0.0000	0.0000	0.0000	17.4000	0.0000	0.000000	59.0000	0.000000
264 74-12	0.3600	14.9200	0.0000	0.0000	0.0000	0.0000	30.3400	0.0000	0.000000	54.3600	0.000000
265 75-26	8.5400	15.0200	0.0000	0.0000	0.0000	0.0000	12.2900	0.0000	0.718200	35.3300	1.518480
266 76-29	0.4600	11.1200	0.0000	0.0000	0.0000	0.0000	12.2100	0.0000	0.747600	35.5900	1.580640
267 77-25	8.4500	15.4800	8.4500	0.0000	0.0000	0.0000	12.5300	0.0000	0.000000	35.3400	0.000000
268 78-48	3.5000	4.3300	5.6600	0.0000	0.0000	0.0000	17.9200	0.0000	0.717150	42.3300	1.516260
269 79-43	0.7700	6.8600	8.4900	0.0000	0.0000	0.0000	20.7700	0.0000	0.314300	45.4400	0.664520
270 80-46	3.5900	4.3000	19.9800	0.0000	0.0000	0.0000	17.4200	0.0000	0.214900	43.0300	0.454360

Ø Glass	12 B203	13 U02	14 SrO	15 ZrO2	16 TiO2	17 K2O	18 Cs2O	19 Sb2O3	20 P2O5	21 Nd2O3
217 25-64	11.5900	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
218 26-10	19.3100	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
219 27-2	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
220 28-45	9.7700	1.061450	0.138450	0.184600	0.0000	0.036920	0.138450	0.0000	2.510560	0.166140
221 29-37	0.0000	1.060300	0.138300	0.184400	0.0000	0.036880	0.138300	0.0000	2.507840	0.165960
222 30-14	0.0000	2.451800	0.319800	0.428400	0.0000	0.085280	0.319800	0.0000	5.709040	0.363760
223 31-1	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
224 32-70	19.8300	2.346000	0.306000	0.408000	0.0000	0.081600	0.306000	0.0000	5.548800	0.367200
225 33-6	19.2200	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
226 34-18	19.9200	2.339100	0.305100	0.406800	0.0000	0.081360	0.305100	0.0000	5.532460	0.366120
227 35-35	10.4400	1.072950	0.139950	0.186600	0.0000	0.037320	0.139950	0.0000	2.537760	0.167940
228 36-19	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
229 37-31	0.0000	2.459850	0.320850	0.427800	0.0000	0.085560	0.320850	0.0000	5.818060	0.365020
230 38-53	0.0000	0.586500	0.076500	0.102000	0.0000	0.020400	0.076500	0.0000	1.387200	0.091800
231 39-59	0.0000	0.645150	0.084150	0.112200	0.0000	0.022440	0.084150	0.0000	1.525920	0.100960
232 40-47	9.5400	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
233 41-63	9.7300	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
234 42-34	8.1000	0.884350	0.115350	0.153800	0.0000	0.030760	0.115350	0.0000	2.091680	0.136420
235 43-11	0.0000	2.415000	0.315000	0.420000	0.0000	0.084000	0.315000	0.0000	5.712000	0.376000
236 44-23	0.0000	2.410400	0.314400	0.419200	0.0000	0.083840	0.314400	0.0000	5.701120	0.377280
237 45-17	0.0000	2.438000	0.318000	0.424000	0.0000	0.084800	0.318000	0.0000	5.766400	0.381600
238 46-58	0.0000	1.532950	0.199950	0.266800	0.0000	0.053320	0.199950	0.0000	3.625760	0.239940
239 47-4	6.0100	2.254000	0.294000	0.392000	0.0000	0.078400	0.294000	0.0000	5.331200	0.352800
240 48-32	0.0000	2.252850	0.293850	0.391800	0.0000	0.078360	0.293850	0.0000	5.328480	0.352620
241 49-13	20.0500	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
242 50-5	0.0000	2.316100	0.302100	0.402800	0.0000	0.080560	0.302100	0.0000	5.478080	0.362520
243 51-66	10.3100	0.423200	0.055200	0.073600	0.0000	0.014720	0.055200	0.0000	1.000960	0.066240
244 52-42	6.6700	0.700350	0.091350	0.121800	0.0000	0.024360	0.091350	0.0000	1.656480	0.109620
245 53-52	0.0000	0.746350	0.097350	0.129800	0.0000	0.025960	0.097350	0.0000	1.765260	0.116820
246 54-72	19.7400	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
247 55-27	19.6200	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
248 56-68	0.0000	2.525400	0.329400	0.439200	0.0000	0.087840	0.329400	0.0000	5.973120	0.395280
249 57-7	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
250 58-39	9.2900	1.031650	0.134550	0.179400	0.0000	0.035680	0.134550	0.0000	2.439640	0.161460
251 59-6	19.4500	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
252 60-20	23.5600	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
253 61-60	8.9100	1.307550	0.170550	0.227400	0.0000	0.045480	0.170550	0.0000	3.092640	0.204660
254 62-54	20.0400	1.418800	0.184800	0.246400	0.0000	0.049280	0.184800	0.0000	3.351040	0.221760
255 63-34	8.0200	0.953350	0.124350	0.165800	0.0000	0.033160	0.124350	0.0000	2.254860	0.149220
256 64-28	19.8700	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
257 65-49	0.0000	1.853800	0.241800	0.322400	0.0000	0.064480	0.241800	0.0000	4.384640	0.290160
258 67-75	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
259 68-50	8.5900	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
260 69-16	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
261 70-55	19.7700	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
262 72-2	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
263 73-1	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
264 74-12	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
265 75-26	8.3000	2.359800	0.307800	0.410400	0.0000	0.062080	0.307800	0.0000	5.581440	0.369360
266 76-29	19.2500	2.456400	0.320400	0.427200	0.0000	0.065440	0.320400	0.0000	5.809920	0.384480
267 77-25	19.7800	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
268 78-48	5.7700	2.356350	0.307350	0.409800	0.0000	0.061960	0.307350	0.0000	5.573260	0.368620
269 79-43	8.7000	1.032700	0.134700	0.179600	0.0000	0.035920	0.134700	0.0000	2.442560	0.161640
270 80-46	5.5300	0.706100	0.092100	0.122800	0.0000	0.024560	0.092100	0.0000	1.670060	0.110520

Ø Glass	22 BaO	23 PbO	24 ThO2	25 28-D NSi (g/m**2)	26 pH	27 St. Ghyl (KC/Mol)	28 Jantzen's St. Ghyl	29 Ghyl (KC/Mol)	30 Jantzen's Ghyl
217 25-64	0.0000	0.0000	0.000000	4.000000	8.500000	-3.538241	-2.943852	-3.669091	-3.074502
218 26-10	0.0000	0.0000	0.000000	25.300000	9.000000	-2.282323	-1.975920	-2.819358	-2.332955
219 27-2	0.0000	0.0000	0.000000	704.100000	12.700000	-9.725183	-6.749455	-14.477557	-11.501849
220 28-45	0.0000	0.0000	3.278650	22.600000	10.200000	-12.263918	-8.295234	-14.279278	-10.310594
221 29-37	0.0000	0.0000	3.273100	10.800000	10.300000	-10.738462	-7.089181	-11.398249	-7.746968
222 30-14	0.0000	0.0000	7.568600	7.500000	10.000000	-12.805614	-8.132805	-13.219215	-8.546405
223 31-1	0.0000	0.0000	0.000000	8.700000	10.300000	-8.483154	-5.676188	-9.140940	-8.333974
224 32-70	0.0000	0.0000	7.242000	10.300000	8.600000	-8.950284	-5.859960	-7.111735	-6.021431
225 33-6	0.0000	0.0000	0.000000	4.400000	8.800000	-2.585856	-2.263260	-2.828559	-2.505963
226 34-18	0.0000	0.0000	7.220700	12.800000	9.000000	-7.175581	-5.994434	-7.175581	-5.994434
227 35-35	0.0000	0.0000	3.312150	19.700000	10.400000	-14.445197	-9.350742	-16.901479	-11.807025
228 36-19	0.0000	0.0000	0.000000	76.300000	12.000000	-11.945335	-7.729751	-15.090980	-10.875396
229 37-31	0.0000	0.0000	7.593450	1213.000000	13.000000	-30.492708	-14.469231	-36.012665	-19.989188
230 38-53	0.0000	0.0000	1.810500	678.600000	12.200000	-10.278400	-7.062326	-13.848235	-10.632161
231 39-59	0.0000	0.0000	1.991550	5.600000	9.300000	-3.288193	-2.485200	-3.396161	-2.593169
232 40-47	0.0000	0.0000	0.000000	11.600000	10.000000	-10.092494	-8.918338	-11.709067	-8.534911
233 41-63	0.0000	0.0000	0.000000	9.000000	9.000000	-4.043594	-3.272490	-4.400629	-3.629525
234 42-34	0.0000	0.0000	2.729950	13.400000	9.900000	-10.168907	-7.078708	-11.603506	-8.513307
235 43-11	0.0000	0.0000	7.455000	3.600000	8.800000	-2.775480	-2.334333	-2.811748	-2.370600
236 44-23	0.0000	0.0000	7.440800	521.400000	12.600000	-18.863658	-11.276533	-23.168051	-15.780927
237 45-17	0.0000	0.0000	7.526000	24.900000	11.000000	-17.454859	-10.964918	-18.927548	-12.437608
238 46-56	0.0000	0.0000	4.732150	8.300000	9.600000	-6.419445	-4.585589	-6.618642	-4.784787
239 47-4	0.0000	0.0000	6.958000	10.000000	9.900000	-3.970344	-3.313697	-5.404943	-4.748298
240 48-32	0.0000	0.0000	6.954450	9.700000	9.100000	-2.328443	-1.936549	-2.398770	-2.006875
241 49-13	0.0000	0.0000	0.000000	31.700000	9.900000	-9.541452	-6.751768	-10.978050	-8.186367
242 50-5	0.0000	0.0000	7.149700	15.300000	10.300000	-5.959848	-4.642651	-6.617635	-5.300438
243 51-66	0.0000	0.0000	1.306400	6.700000	9.400000	-3.079194	-2.572920	-3.791872	-3.285599
244 52-42	0.0000	0.0000	2.161950	14.500000	10.500000	-13.637972	-8.464886	-16.328649	-11.155564
245 53-52	0.0000	0.0000	2.303950	21.700000	10.200000	-6.480682	-4.519789	-7.049062	-5.088169
246 54-72	0.0000	0.0000	0.000000	10.000000	9.800000	-15.554898	-9.866087	-16.819772	-11.130962
247 55-27	0.0000	0.0000	0.000000	97.300000	12.200000	-20.119515	-12.154959	-27.972080	-20.007525
248 56-88	0.0000	0.0000	7.795800	9.400000	9.000000	-4.703472	-3.597838	-4.759986	-3.654352
249 57-7	0.0000	0.0000	0.000000	16.000000	9.500000	-0.570176	-0.462497	-0.733400	-0.625720
250 58-39	0.0000	0.0000	3.184350	8.800000	9.100000	-5.919061	-4.510180	-6.348007	-4.947126
251 59-6	0.0000	0.0000	0.000000	4.300000	8.800000	-2.854635	-2.321639	-2.897337	-2.564342
252 60-20	0.0000	0.0000	0.000000	20.900000	8.900000	-3.835519	-3.284179	-4.130770	-3.579430
253 61-60	0.0000	0.0000	4.036350	33.300000	9.700000	-6.466122	-4.988898	-7.573835	-6.076611
254 62-54	0.0000	0.0000	4.373600	24.900000	9.700000	-13.899309	-9.277399	-15.007022	-10.385112
255 63-34	0.0000	0.0000	2.942950	13.400000	9.800000	-10.380784	-7.204642	-11.645659	-8.469517
256 64-28	0.0000	0.0000	0.000000	23.700000	9.500000	-7.588320	-5.603666	-8.399959	-6.435305
257 65-49	0.0000	0.0000	5.722600	9.200000	10.200000	-11.536688	-7.195589	-12.105047	-7.763969
258 67-75	0.0000	0.0000	0.000000	61.000000	11.900000	-13.076566	-8.305906	-16.022241	-11.251581
259 68-50	0.0000	0.0000	0.000000	88.500000	13.200000	2.020284	1.859389	-10.437945	-10.606839
260 69-16	0.0000	0.0000	0.000000	7.200000	10.100000	-7.574903	-4.957812	-8.061825	-5.444733
261 70-55	0.0000	0.0000	0.000000	122.600000	11.800000	-16.291378	-10.719840	-22.689551	-17.118013
262 72-2	0.0000	0.0000	0.000000	812.800000	12.700000	-10.448461	-7.143862	-15.200865	-11.896256
263 73-1	0.0000	0.0000	0.000000	7.900000	10.200000	-9.257832	-6.088322	-9.826212	-6.656702
264 74-12	0.0000	0.0000	0.000000	99.700000	12.500000	-19.316816	-10.545632	-23.578056	-14.807073
265 75-26	0.0000	0.0000	7.284600	8.400000	9.400000	-14.151880	-9.121807	-14.864559	-9.834486
266 76-29	0.0000	0.0000	7.582800	57.800000	9.700000	-13.214282	-9.243846	-14.321995	-10.351559
267 77-25	0.0000	0.0000	0.000000	9.200000	9.700000	-11.317473	-7.675418	-12.425186	-8.783131
268 78-48	0.0000	0.0000	7.273950	12.200000	9.700000	-10.690176	-7.526324	-11.697889	-8.634037
269 79-43	0.0000	0.0000	3.187900	90.300000	10.700000	-11.520592	-7.811604	-14.704242	-10.995254
270 80-46	0.0000	0.0000	2.179700	17.000000	10.000000	-8.838751	-4.992535	-8.455324	-6.609108

Ø Glass	31 NBO	32 Val. Par.	33
217 25-64	0.177542	-0.615041	1.386294
218 26-10	0.189728	-0.678208	3.230804
219 27-2	0.500711	-0.304261	6.556920
220 28-45	0.046831	-0.424929	3.117950
221 29-37	0.592187	-0.464256	2.360854
222 30-14	0.769534	-0.663468	2.014903
223 31-1	0.562974	-0.613566	2.163323
224 32-70	0.291351	-0.645538	2.332144
225 33-8	0.144741	-0.686873	1.481606
226 34-10	0.367430	-0.616546	2.549445
227 35-35	0.048582	-0.358500	2.980619
228 36-19	0.393256	-0.224696	4.334673
229 37-31	1.205997	-0.183620	7.100852
230 38-53	0.010191	-0.286957	6.520032
231 39-59	0.328352	-0.837212	1.722767
232 40-47	0.481923	-0.435107	2.451005
233 41-63	0.165288	-0.592208	2.197225
234 42-34	0.534363	-0.458034	2.595255
235 43-11	0.389093	-0.711847	1.280934
236 44-23	0.839512	-0.140607	6.256518
237 45-17	0.791054	-0.198321	3.214868
238 46-56	0.337858	-0.671017	2.116256
239 47-4	0.472601	-0.661449	2.302595
240 48-32	0.193681	-0.714465	2.272126
241 49-13	0.581258	-0.625651	3.456317
242 50-5	0.579116	-0.556246	2.727853
243 51-66	0.242064	-0.634716	1.902108
244 52-42	0.700037	-0.501089	2.674149
245 53-52	0.596571	-0.710509	3.077312
246 54-72	0.578118	-0.430433	2.302585
247 55-27	0.688776	-0.026317	4.577799
248 56-68	0.623961	-0.818049	2.240710
249 57-7	0.189470	-0.712902	2.772589
250 58-39	0.386596	-0.664126	2.174752
251 59-6	0.146078	-0.684707	1.458615
252 60-20	-0.017048	-0.626510	3.039749
253 61-60	0.419828	-0.548057	3.505557
254 62-54	0.696100	-0.595816	3.214868
255 63-34	0.543917	-0.453184	2.595255
256 64-28	0.327945	-0.598665	3.165475
257 65-49	0.705468	-0.652480	2.219203
258 67-75	0.362779	-0.203064	4.110874
259 68-50	-0.028857	-0.829961	4.483003
260 69-16	0.384052	-0.676290	1.974081
261 70-55	0.544752	0.009713	4.808927
262 72-2	0.529538	-0.279452	6.700485
263 73-1	0.584029	-0.593376	2.066863
264 74-12	0.903649	-0.239932	4.602166
265 75-26	0.748322	-0.638715	2.128232
266 76-29	0.759503	-0.587574	4.056989
267 77-25	0.460858	-0.607810	2.219203
268 78-48	0.637852	-0.495497	2.501436
269 79-43	0.626032	-0.414120	4.503137
270 80-46	0.350132	-0.524219	2.833213

0 Glass	1 Al2O3	2 CaO	3 Fe2O3	4 FeO	5 MgO	6 MnO	7 Na2O	8 Li2O	9 NiO	10 SiO2	11 Cr2O3
271 81-34	4.4200	8.3700	7.9100	0.0000	0.0000	0.0000	19.6300	0.0000	0.294700	45.2300	0.623080
272 82-24	0.3400	0.0000	0.0000	0.0000	0.0000	0.0000	29.3300	0.0000	0.610400	33.8100	1.290560
273 83-8	0.4400	0.2500	0.0000	0.0000	0.0000	0.0000	21.0300	0.0000	0.000000	58.8100	0.000000
274 84-51	0.9300	0.2000	14.9000	0.0000	0.0000	0.0000	12.3400	0.0000	0.535850	38.5900	1.132940
275 85-16	8.8300	15.8400	20.0000	0.0000	0.0000	0.0000	12.5900	0.0000	0.000000	42.7400	0.000000
276 86-88	12.2200	0.1000	0.0000	0.0000	0.0000	0.0000	26.6800	0.0000	0.000000	61.0000	0.000000
277 87-88	7.9100	13.8400	4.6200	0.0000	0.0000	0.0000	28.1100	0.0000	0.207550	39.5900	0.438820
278 88-91	0.5000	15.1700	2.5600	0.0000	0.0000	0.0000	18.1900	0.0000	0.214200	51.5400	0.452860
279 89-77	8.0000	0.1600	17.9800	0.0000	0.0000	0.0000	12.1900	0.0000	0.000000	45.0100	0.000000
280 90-85	0.7000	12.2800	12.6400	0.0000	0.0000	0.0000	12.1800	0.0000	0.603050	44.9700	1.275020
281 91-89	12.4600	0.1900	10.1400	0.0000	0.0000	0.0000	15.1300	0.0000	0.377300	41.7000	0.797720
282 92-84	3.6400	5.1200	8.6400	0.0000	0.0000	0.0000	18.7100	0.0000	0.524650	44.1700	1.109260
283 93-81	0.3100	8.3800	0.0000	0.0000	0.0000	0.0000	12.8800	0.0000	0.469350	47.5400	0.992340
284 94-92	3.4400	0.2500	0.0000	0.0000	0.0000	0.0000	18.7500	0.0000	0.717850	51.1700	1.517740
285 95-90	12.8100	9.9700	10.2700	0.0000	0.0000	0.0000	15.2500	0.0000	0.382550	40.7700	0.808820
286 96-76	0.3200	12.9700	0.0000	0.0000	0.0000	0.0000	28.5400	0.0000	0.000000	60.1700	0.000000
287 97-82	0.2700	11.7600	0.0000	0.0000	0.0000	0.0000	22.7000	0.0000	0.641603	48.3400	1.356533
288 98-79	0.6100	0.4400	9.6400	0.0000	0.0000	0.0000	26.5800	0.0000	0.647150	44.2400	1.368260
289 99-78	0.9200	12.1700	14.5400	0.0000	0.0000	0.0000	12.7900	0.0000	0.374150	48.8900	0.791060
290 100-93	4.6100	7.8100	10.8600	0.0000	0.0000	0.0000	10.2600	0.0000	0.387100	55.4100	0.818440
291 101-80	7.2700	13.0900	7.4700	0.0000	0.0000	0.0000	11.9600	0.0000	0.000000	43.1400	0.000000
292 102-87	11.6500	0.1900	0.0000	0.0000	0.0000	0.0000	9.9700	0.0000	0.648550	42.7600	1.371220
293 103-83	0.3300	10.6400	0.0000	0.0000	0.0000	0.0000	22.1000	0.0000	0.000000	52.1800	0.000000
294 SRL-165NR	4.8800	0.9700	10.8000	0.0000	0.7500	0.0000	10.9000	5.0500	0.850000	51.3600	0.140000
295 WV205NR	3.3100	0.6100	11.8400	0.0000	1.3100	0.0000	11.0300	3.0500	0.700000	45.2000	0.220000
296 UK209	5.2200	0.0000	11.7100	0.0000	5.6900	0.0000	8.2500	4.0900	0.330000	53.0200	0.360000
297 SRL-131	3.0500	1.0400	14.2800	0.0000	1.2400	0.0000	14.7700	3.8900	1.540000	38.6000	0.180000

0 Glass	12 B203	13 U02	14 Sr0	15 Zr02	16 Ti02	17 K20	18 Cs20	19 Sb203	20 P205	21 Nd203
271 81-34	0.0200	0.968300	0.128300	0.168400	0.0000	0.033600	0.126300	0.0000	2.290240	0.151560
272 82-24	19.0900	2.005600	0.261600	0.348800	0.0000	0.069760	0.261600	0.0000	4.743680	0.313920
273 83-8	19.4700	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
274 84-51	19.7400	1.760650	0.229650	0.306200	0.0000	0.061240	0.229650	0.0000	4.164320	0.275580
275 85-16	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
276 86-88	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
277 87-86	0.0000	0.681950	0.088950	0.118600	0.0000	0.023720	0.088950	0.0000	1.612960	0.106740
278 88-91	5.9200	0.703800	0.091800	0.122400	0.0000	0.024480	0.091800	0.0000	1.664640	0.110160
279 89-77	16.8600	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
280 90-95	0.0000	1.981450	0.258450	0.344600	0.0000	0.068920	0.258450	0.0000	4.686560	0.310140
281 91-89	9.6100	1.239700	0.161700	0.215600	0.0000	0.043120	0.161700	0.0000	2.932160	0.194040
282 92-84	6.7300	1.723850	0.224850	0.299800	0.0000	0.059960	0.224850	0.0000	4.077280	0.269820
283 93-81	17.4900	1.542150	0.201150	0.268200	0.0000	0.053640	0.201150	0.0000	3.647520	0.241380
284 94-92	5.8700	2.358650	0.307650	0.410200	0.0000	0.082040	0.307650	0.0000	5.578720	0.369180
285 95-90	0.0000	1.266950	0.163950	0.218600	0.0000	0.043720	0.163950	0.0000	2.972960	0.196740
286 96-76	0.0000	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
287 97-82	0.0000	2.108126	0.274973	0.366631	0.0000	0.073326	0.274973	0.0000	4.986176	0.329967
288 98-79	0.0000	2.126350	0.277350	0.369800	0.0000	0.073960	0.277350	0.0000	5.029280	0.332820
289 99-78	0.0000	1.229350	0.160350	0.213800	0.0000	0.042760	0.160350	0.0000	2.907680	0.192420
290 100-93	0.0000	1.271900	0.165900	0.221200	0.0000	0.044240	0.165900	0.0000	3.008320	0.199080
291 101-80	17.0700	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
292 102-87	16.8900	2.130950	0.277950	0.370600	0.0000	0.074120	0.277950	0.0000	5.040160	0.333540
293 103-83	14.5600	0.000000	0.000000	0.000000	0.0000	0.000000	0.000000	0.0000	0.000000	0.000000
294 SRL-165NR	7.1200	0.000000	0.030000	1.520000	0.0000	0.090000	0.000000	0.0000	0.030000	0.600000
295 WV205NR	9.9600	0.000000	0.120000	3.120000	0.9700	3.510000	0.100000	0.0000	2.520000	0.000000
296 UK209	10.8800	0.000000	0.310000	1.280000	0.0000	0.000000	0.500000	0.0000	0.000000	1.720000
297 SRL-131	9.8400	1.620000	0.140000	0.310000	0.7500	0.120000	0.300000	0.0000	0.100000	0.450000

Ø Glass	22 BaO	23 PbO	24 ThO2	25 28-D NSi (g/m**2)	26 pH	27 St. Ghyl (KC/Mol)	28 Jantzen's St. Ghyl	29 Ghyl (KC/Mol)	30 Jantzen's Ghyl
271 81-34	0.0000	0.0000	2.989100	13.500000	8.500000	-10.314835	-7.167023	-10.445885	-7.297873
272 82-24	0.0000	0.0000	6.191200	271.300000	10.900000	-19.333386	-12.599991	-23.038363	-16.304969
273 83-8	0.0000	0.0000	0.000000	198.900000	10.200000	-7.177283	-5.641478	-9.192643	-7.656838
274 84-51	0.0000	0.0000	5.435050	67.200000	8.900000	-6.100043	-5.087136	-6.395294	-5.362388
275 85-18	0.0000	0.0000	0.000000	7.600000	8.800000	-7.516454	-4.925586	-7.552721	-4.961854
276 86-88	0.0000	0.0000	0.000000	68.700000	12.400000	-7.761089	-5.620676	-11.785336	-9.644923
277 87-86	0.0000	0.0000	2.105150	11.600000	11.200000	-21.775126	-11.508035	-23.531558	-13.262467
278 88-91	0.0000	0.0000	2.172600	34.200000	10.600000	-12.524177	-7.950364	-15.457535	-10.883721
279 89-77	0.0000	0.0000	0.000000	5.700000	8.900000	-2.572116	-2.199945	-2.867367	-2.495196
280 90-85	0.0000	0.0000	6.116650	12.900000	9.900000	-8.687779	-5.892048	-9.038209	-6.240477
281 91-89	0.0000	0.0000	3.626900	8.800000	8.900000	-5.392197	-4.342957	-5.687448	-4.638207
282 92-84	0.0000	0.0000	5.321450	13.000000	9.700000	-10.315252	-7.275800	-11.422965	-8.383513
283 93-81	0.0000	0.0000	4.760550	63.200000	9.400000	-8.942820	-6.700097	-9.655498	-7.412776
284 94-92	0.0000	0.0000	7.281050	6.600000	9.600000	-6.161145	-6.241744	-9.124432	-7.205031
285 95-90	0.0000	0.0000	3.880150	8.900000	9.200000	-9.067690	-6.152704	-9.154969	-6.239983
286 96-76	0.0000	0.0000	0.000000	79.800000	11.700000	-14.081069	-8.500507	-16.651057	-11.070495
287 97-82	0.0000	0.0000	6.507692	7.227877	1.693299	-18.480432	-9.661898	-16.460432	-9.861898
288 98-79	0.0000	0.0000	6.563950	39.300000	11.100000	-13.381584	-8.838050	-14.993470	-10.449937
289 99-78	0.0000	0.0000	3.794950	11.800000	10.100000	-7.236782	-4.986703	-7.723683	-5.473625
290 100-93	0.0000	0.0000	3.926300	6.400000	9.200000	-3.259093	-2.525318	-3.346371	-2.612697
291 101-80	0.0000	0.0000	0.000000	8.700000	9.500000	-8.494814	-6.092328	-9.326453	-6.923987
292 102-87	0.0000	0.0000	6.578150	5.300000	8.500000	-4.906344	-4.239497	-5.037194	-4.370348
293 103-83	0.0000	0.0000	0.000000	29.600000	10.200000	-12.658976	-8.389462	-14.074335	-10.404822
294 SRL-165NR	0.1100	0.1100	0.000000	14.320000	10.000000	-6.019849	-4.367263	-7.036421	-5.983836
295 WV205NR	0.0600	0.0000	0.000000	16.320000	9.780000	-7.328469	-5.293298	-8.560900	-6.525728
296 UK209	0.3700	0.0000	0.000000	12.600000	9.400000	-5.584569	-4.076383	-6.297247	-4.789062
297 SRL-131	0.0100	0.0000	0.000000	24.330000	10.100000	-10.433845	-7.038166	-12.244196	-8.646617

Ø Glass	31 N80	32 Val. Par.	33
271 81-34	0.543334	-0.458919	2.802690
272 82-24	0.824230	0.008376	5.803225
273 83-8	0.422591	-0.413539	5.292802
274 84-51	0.305876	-0.592646	4.207673
275 85-16	0.388634	-0.680580	2.028148
276 86-88	0.398639	-0.389897	4.229749
277 87-86	0.843012	-0.252875	2.451005
278 88-91	0.745345	-0.517704	3.532228
279 89-77	0.012297	-0.853587	1.740488
280 90-85	0.652157	-0.675439	2.557227
281 91-89	0.194802	-0.584977	2.174752
282 92-84	0.592987	-0.479691	2.584949
283 93-81	0.594508	-0.612852	4.146304
284 94-92	0.579849	-0.499831	1.887070
285 95-90	0.447469	-0.808282	2.188051
286 96-76	0.788861	-0.358905	4.379524
287 97-82	0.930362	-0.406962	1.977945
288 98-79	0.727213	-0.282310	3.871225
289 99-78	0.659821	-0.670771	2.468100
290 100-93	0.372490	-0.749792	1.856298
291 101-80	0.408994	-0.651775	2.163323
292 102-87	0.248326	-0.707323	1.867707
293 103-83	0.670573	-0.378738	3.387774
294 SRL-165NR	0.420819	-0.443201	2.861857
295 WV205NR	0.481790	-0.462581	2.792391
296 UK209	0.425780	-0.582585	2.533697
297 SRL-131	0.536022	-0.304210	3.191710

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